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REMEDIAL INVESTIGATION REPORT
SAUNDERS SUPPLY COMPANY
ALTERNATIVE REMEDIAL CONTRACTS STRATEGY (ARCS) REGION III

Work Assignment (WA) 85-02-3LP6
Volume II: Appendices

May 1991

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UNITED STATES ENVIRONMENTAL
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International Specialists in the Environment

TABLE OF CONTENTS

APPENDIX (VOLUME II)

APPENDIX A

COMMUNITY RELATIONS:
APRIL 4, 1989, MEETING

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International Specialists in the Environment

April 19, 1989

Ms. Theresa Bickel
Community Relations Coordinator
U.S. Environmental Protection Agency
841 Chestnut Building
Philadelphia, PA 19107

Dear Theresa:

I have enclosed a meeting summary for the Public Information Meeting which was held April 4, 1989, regarding the Saunders Supply Company site. A mailing list from those who signed in at the meeting, and a list of the questions and answers exchanged during the meeting are included as attachments, as well as copies of the overheads. I have presented the questions and answers as they were spoken. If you have any editorial or other changes to make, please let me know.

Sincerely,

Jone Watson

JW/smj

Attachments

Saunders Supply Company
Public Information Meeting
April 4, 1989

Introduction

A public information meeting regarding the Saunders Supply Company Site was held Tuesday evening, April 4, 1989, at the Oakland Elementary School, Suffolk, Virginia. Community interviews had been held December 15-16, 1988, during which interest was expressed by residents for an information meeting on EPA activities. Approximately 40 persons attended the meeting. Information was presented on the Superfund process, the Community Relations Program, past site activities, state involvement, and the Remedial Investigation/Feasibility Study. After these presentations, the floor was opened for questions and comments. The length of the meeting was approximately 2 hours.

The meeting was conducted by the following individuals:

Theresa Bickel, Community Relations Coordinator, U.S. EPA
Andrew Palestini, Project Manager, U.S. EPA
Tim Longe, Project Manager, Virginia Department of Waste Management

Chris Jones, the councilman from the Chuckatuck borough, opened the meeting with introductions. He stated that the meeting would be conducted by EPA officials, and that he was in attendance as an elected official from the area. He introduced other local officials in attendance: Tom Hines, Director of Public Works; Tom Underwood, Assistant City Manager; Mark Thompson, Director of Public Utilities.

Presentations

Theresa Bickel - Community Relations Coordinator, U.S. Environmental Protection Agency

Theresa Bickel began the presentation by explaining EPA's Superfund process, as it relates to the Saunders Supply Company site, and the

Community Relations Program, as a component of it. EPA begins the process by verifying the existence of hazardous substances on-site. In this case, the State of Virginia did the initial verification. EPA then determined that further sampling was required, and based on the sampling results, determined that a potential threat to human health and the environment existed. The site was then proposed for the National Priorities List (NPL), EPA's list of potential hazardous waste sites. Once a site is proposed for the NPL, a Remedial Investigation/Feasibility Study (RI/FS) is conducted. The Remedial Investigation (RI) determines the nature and extent of the contamination. This is followed by the Feasibility Study (FS) which determines the alternatives available to cleanup the site. The Saunders Supply Company site is at the RI point in the process.

EPA has an active Community Relations Program. The Community Relations Plan for Saunders Supply Company was developed after community interviews were conducted in December, 1988, and is a guide for communication between the EPA and residents of the community. It is available for review in the Information Repository, which has been established at the Morgan Memorial Library. The Information Repository will contain all documents generated by the EPA regarding the site, including the Community Relations Plan, the RI/FS, workplans for this study, and any fact sheets. After the RI/FS, the EPA will develop a proposed plan for cleanup of the site. Comments by residents of the community on this proposed plan will be solicited, and a public meeting will be scheduled. The final stage is implementation of the cleanup.

Under Superfund, residents of a community may apply for Technical Assistance Grants by forming a citizens group. Technical Assistance Grants allow for a community to enlist a technical advisor for assistance in reviewing EPA's work on-site.

Theresa Bickel stated that she was available to address residents' questions, comments or concerns. Residents may also telephone Chris Jones, or Jamie Walters, the Community Relations Coordinator for the State of Virginia. She then introduced John Horn and Tim Longe, Project Managers for the State of Virginia.

Tim Longe - Project Manager, Virginia Department of Waste Management

Tim Longe spoke on the State's involvement at the Saunders Supply Company site. The State of Virginia, Department of Waste Management will oversee activities of the EPA to ensure that the EPA acts in conformance with existing state regulations, and that cleanup activities are satisfactory to the State. They also are available to listen to community concerns.

Andrew Palestini - Project Manager, U.S. Environmental Protection Agency

Andrew Palestini presented plans for the study of the site. The purpose of the RI part of the study is to define the extent and direction of contamination, and to identify the risk associated with the contamination. The purpose of the FS will be to determine methods to mitigate the contamination and the risk. Since EPA does not have the in-house personnel to conduct these studies, the agency has hired a consulting engineering firm, Ecology and Environment, Inc., to conduct the study under the direction of EPA.

Andrew Palestini explained the processes and chemicals which were involved at the site. The plant initially used a pentachlorophenol (PCP) process to treat wood. This process was begun in 1964 and gradually phased out until 1984. In 1974, it began use of a chromated copper arsenic process and it is still used today. As part of the PCP process, sludge was generated, and was burned on site for five years; sludge also was sprayed along an access road. These areas were indicated on the map (see Attachment A), as well as the area where the wood was treated.

Groundwater monitoring wells and other sampling locations will be located throughout the site. Eight new groundwater wells and five existing wells, which had been put in place by the Saunders Supply Company, will test for possible groundwater contamination. A background well, one of the new monitoring wells, will be placed upstream, and at a distance from any possible contamination. It will give an indication of what the natural groundwater is like.

Other samples to be taken include boring samples and surface water and sediment samples. Boring samples will determine where the

contamination is, and how deep it is. Samples will also indicate the level of contamination. Boring samples will be taken on either side of the access road. The exact location of surface water and sediment samples has not been determined. Generally, sediment samples will be taken along the edge and middle of the pond, along the periphery of Godwin's Millpond, the other side of the 10 mile Creek, and Chuckatuck Channel. The purpose is to determine how far contamination has gone.

Air monitoring will also be conducted. The air will be tested based on predictions of an air transport model. Testing will be in a certified EPA laboratory, with properly checked procedures.

Once all the sampling information is in, EPA will identify the risk associated with the site.

After the RI/FS, EPA will evaluate the alternatives to clean up the site, and choose one of these alternatives. The choice will be reflected in an official Record of Decision.

Questions and Answers

Issues raised in the question and answer session related to the sampling process, determination of risk, use of past studies and site investigations, and EPA cost recovery. In addition, residents expressed support for Saunders Supply Company and the remedial work it has done in the past. Questions were answered by Theresa Bickel, Andrew Palestini, Tim Longe, and Bill Hagel, U.S. EPA, Chief of the General Remedial Response Section.

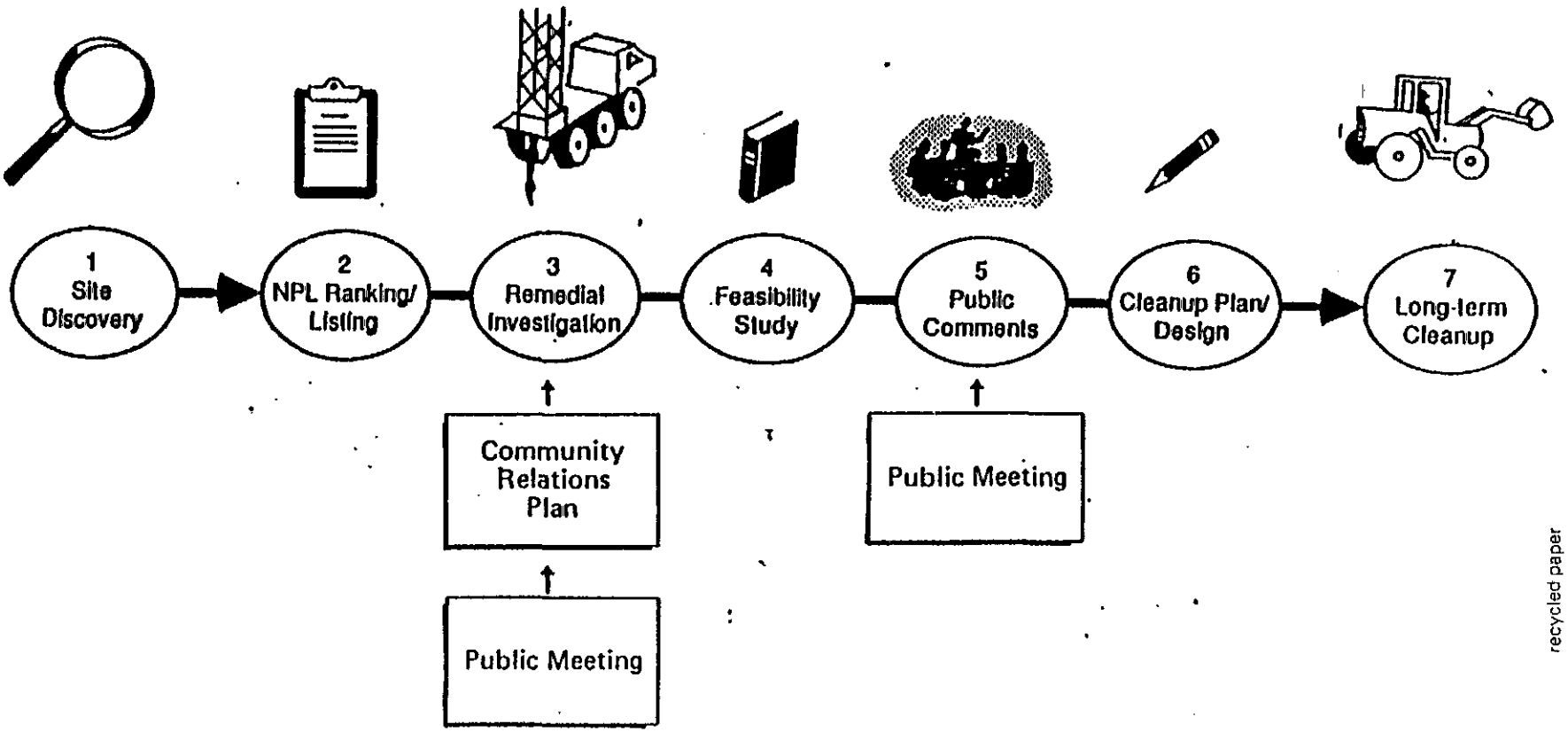
Attachments

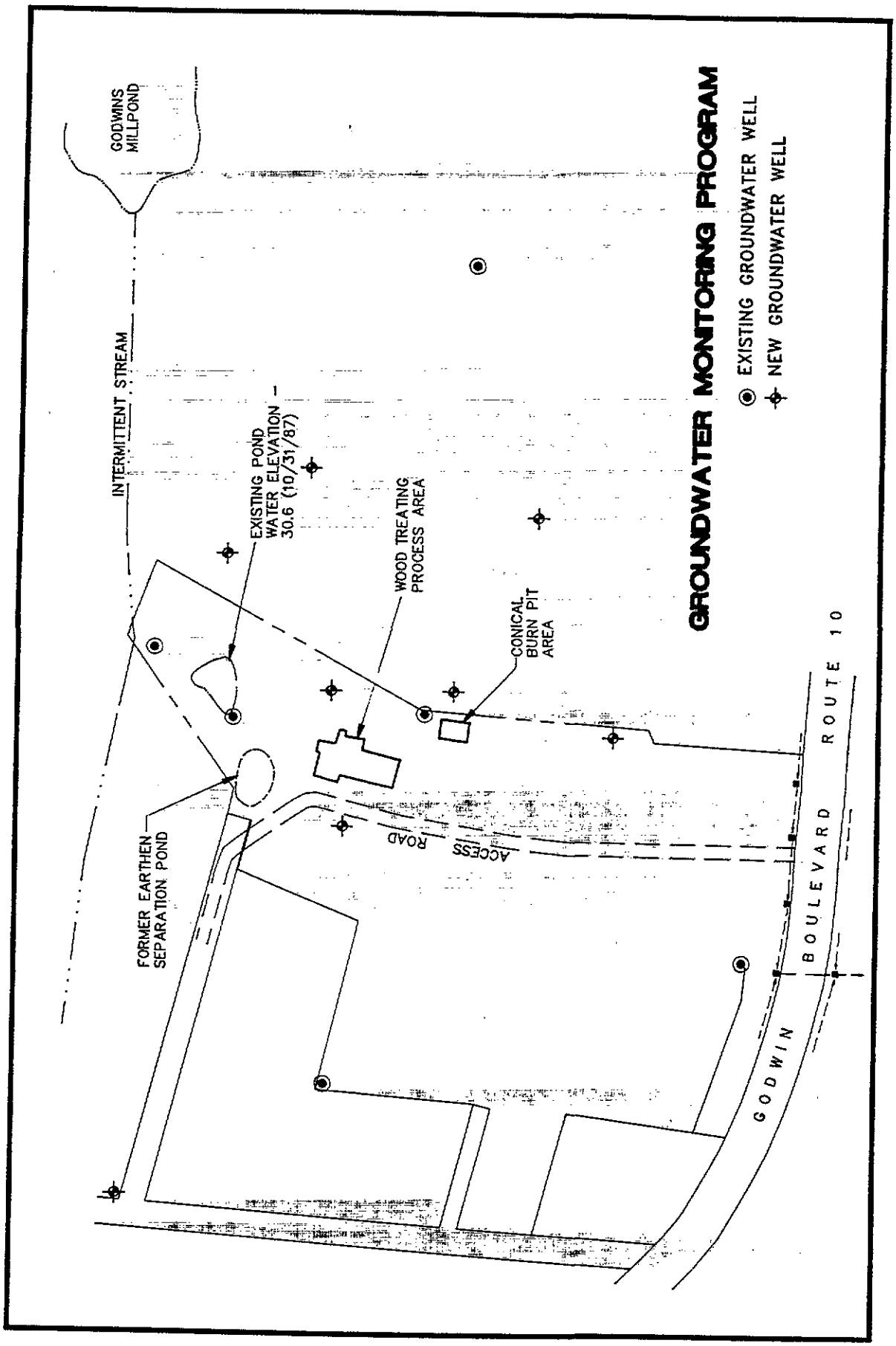
A: Copies of overheads from presentations

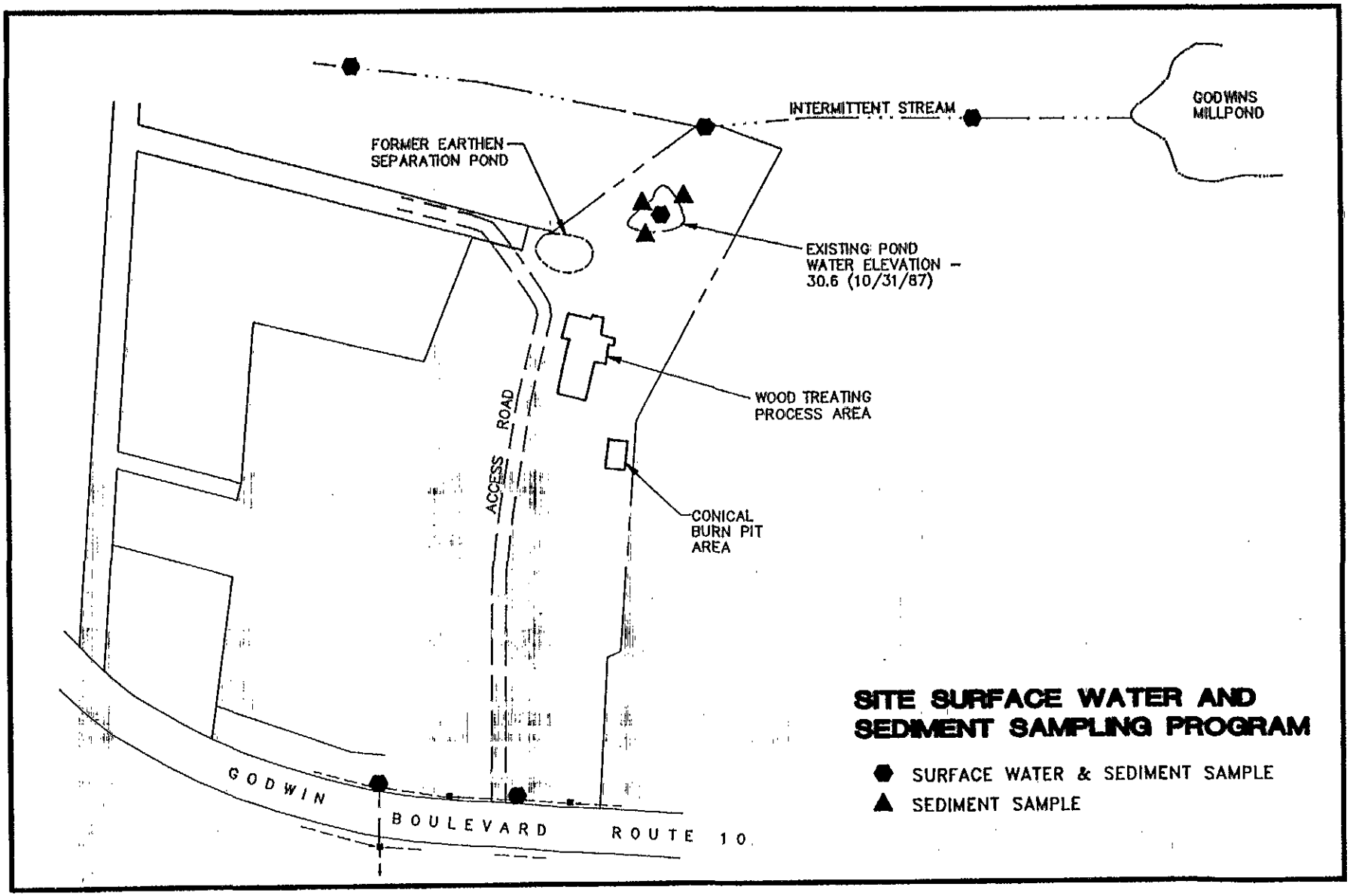
B: List of questions and answers

C: Mailing list (sign-in sheet)

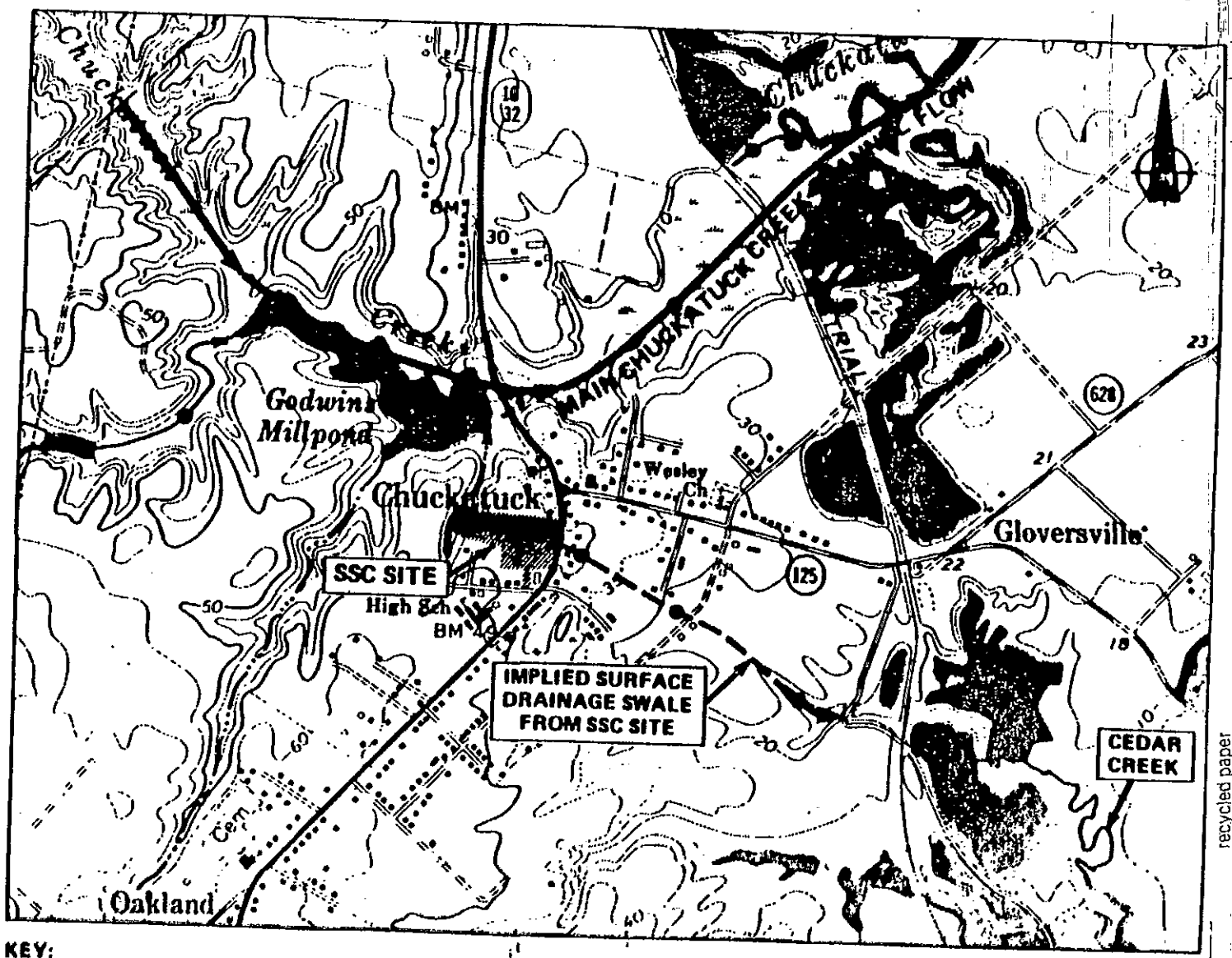
SUPERFUND PROCESS




GROUNDWATER MONITORING PROGRAM
EXISTING GROUNDWATER WELL
NEW GROUNDWATER WELL
GODWINS MILLPOND
INTERMITTENT STREAM
EXISTING POND WATER ELEVATION 30.6 (10/31/87)
WOOD TREATING PROCESS AREA
CONICAL BURN PIT AREA
FORMER EARTHEN SEPARATION POND
ACCESS ROAD
GODWIN BOULEVARD ROUTE 10


INTERMITTENT STREAM
GODWINS MILLPOND
FORMER EARTHEN SEPARATION POND
EXISTING POND WATER ELEVATION - 30.6 (10/31/87)
WOOD TREATING PROCESS AREA
ACCESS ROAD
CONICAL BURN PIT AREA
GODWIN BOULEVARD
ROUTE 10
SITE SURFACE WATER AND SEDIMENT SAMPLING PROGRAM
SURFACE WATER & SEDIMENT SAMPLE
SEDIMENT SAMPLE

OFF-SITE SURFACE WATER AND SEDIMENT SAMPLING PROGRAM



KEY:

● **SURFACE WATER AND SEDIMENT SAMPLE**

Attachment A
Page 4 of 4

QUESTIONS AND ANSWERS

Q: Why are no samples being taken northwest of the stream and east of Godwin's Millpond? Could contamination on the other side of Godwin's Millpond contribute to contamination of the Millpond?

A: EPA is taking samples on the site, behind the site, and along the stream in the direction of flow to the pond. Any contamination found should be what is in the pond. If this is not so, the EPA will know that contamination of the Millpond is coming from a different location.

Q: If EPA took more samples, wouldn't they know from the beginning (if contamination was coming from a different source)?

A: EPA has to limit the number of samples at some point. The sample sites chosen are taken from a surface water model, which predicts how much plume is going into the pond. The model should correlate with any information from the samples in and around the pond. EPA will consider this comment, however.

Q: Gas and diesel fuel have been leaking from a service station into the ground. What effect will this have later on?

A: This is part of the reason why EPA chose the sampling points where they did. The EPA chose sampling points on the Saunders Supply Company side of the boulevard. If they chose points on the other side, they might get interference.

Q: The service station which is leaking is on the SSC side of the boulevard. Why doesn't EPA check it out while they're there?

A: EPA will follow up on that gas leak.

Q: The service station has dug up the topsoil down to the water table and sandbagged it. There is still oil in it.

Saunders Supply Company did not know what they were getting into when they started into "penta." I also do not believe you people knew what was going to be in the ground.

A: Nobody knew what was the best practice at the time, what was environmentally damaging. And now, we're cleaning it up. That is what Superfund is all about.

Q: The Saunders Supply Company caused bushes and trees in my backyard to die. But I still have no intention of leaving.

Q: How and who will investigate the risk potential?

A: Ecology and Environment, with direction from EPA. They will determine how much people have been exposed and in what way.

Q: Saunders Supply Company has been doing that activity for 25 years. I have been here 50 years. No one has been sick from any contamination from Saunders Supply Company. What could the potential danger be? No one has said they're sick or feeling bad.

A: Nothing is happening right now. But that is why EPA is doing the air modelling - to make sure there is not a risk. EPA is not here to put anyone out of business.

Q: If nothing has happened in 25 years, how is EPA smart enough to predict what'll happen 25 years from now?

A: EPA uses toxicology studies of how much people have been exposed and at what levels people start having reactions. This will determine the risk posed by the contaminants.

A: Another example is groundwater. Ten years ago, the groundwater may have been contaminated, and it is only now starting to move from on-site to off-site, and posing a risk. EPA is concerned about that.

Q: If you're testing Saunder's wells and not finding anything, why are you going upstream or elsewhere, if it's not on-site?

A: EPA has to make sure the contamination has not already left the property.

A: Maybe it's not in the groundwater, but moved in the air.

Q: It did go in the air in the old process. Does it stay in the air forever?

A: No; and they're no longer using that process. The example was used to illustrate how contamination could have moved off-site.

A: There are some advantages in having monitoring wells upstream. It can be used as a point of reference to compare with what is on-site and what is downgradient. Also, when PCP was in operation, contaminants went into the air and came down in a particular region, that can be mapped out. To have a comprehensive knowledge of the site, we need to know what is off-site. We will use a progressive analysis to determine if what is on the site is in the pond. If we did an analysis of the the whole area, we could find contaminants everywhere, and it would be very expensive. We are trying to define just the problem of the site. However, a contingency analysis would allow that if a correlation does not exist between the site and the pond, a secondary source may exist on the other side and we may have a supplementary study.

Q: It could be that years ago someone on the other side of the pond used the same chemicals, and those same chemicals are seeping in from that other usage.

A: We are going from the site to the pond. If the progression from the site shows contamination decreasing, and then at the pond, it suddenly jumps up, then we would think of a possible secondary source.

A: We would also look at other industries in the area if there is a greater concentration.

Q: What if the industries are no longer there?

A: The costs would be enormous to take tests everywhere. We're trying to determine what may be coming from the Saunders Supply Company site.

Q: Does the stuff just stay there or does it settle to the bottom?

A: Most of it would settle to the bottom. We see hardly any of it in the water. Depending on how long something stays; and it depends on what happens to it chemically when its in the water itself. We'll be checking both the water and the sediments.

Q: What do we do in the meantime?

A: The water is tested and it is treated. Someone from the city, Mark Thompson, can answer that. How often is the water tested?

A: It is tested daily when it comes into the plant. When we're purifying it, it is tested every three hours to make sure there are no changes. We did a study to determine what would happen if all the CCA spilled into the pond. If all of it came into the plant, we would have 99.9% removal. Even if the whole tank fell into the lake, we would have sufficient treatment process to remove it. What is of the most concern is what is in the sediment. In the summer, we get alot of anerobic action, the water starts stagnating. The iron content goes up, and the other heavy metals would also have a chemical reaction to affect the whole pond, and we would take preventive action.

Q: I have a lumber business. I have worked with treated lumber and my sons have worked with treated lumber, and we've never had any problems. I've eaten fish out of the Millpond. I've been drinking the water from Chuckatuck. I'm not afraid of it. My family owns land directly behind the site, and until I see more reason to be concerned, I'd rather see my tax dollars spent in another way. I don't feel like there's a serious problem here.

A: That's why we're conducting this study. If we determine there is no concern there, we're not going to bother more with it. We're not here to create problems. As far as your tax dollars, Superfund money comes from a tax on petrochemical companies. So, although we tax those companies, it's not really money coming out of your pocket.

Q: Gas just went up from 86 cents to 98 cents a gallon.

A: Regarding the comment about handling dry wood, the exposure from handling dry wood is completely different then when the wood is wet and dripping water, and from burning the sludge or whatever.

Q: You talk about risk to the people. Do you people know what the risk is and how much you have to be exposed to in order to be at risk?

A: It depends on what the contaminants are and how you're exposed to them, and what levels the contaminants are.

Q: That's what I'm asking. Tell me what I have to do to be exposed too much. This site has been going on since 1949. What is the oldest site you people have tested? That gives you 60 years of wood treating information for testing people in the area.

A: It is difficult to extrapolate information from this site to other sites. It depends on what the contaminants are, and the soils could be different. It could hide it more, or release it more. Risk is based on laboratory studies of the contaminants.

Q: A sample of water was taken 18 months ago. Was there risk at that time?

A: No, it was not an immediate risk. If it had been an immediate risk, we would then have gone out and done something. This is a long-term study because it may have long-term impacts. Testing that was done previously is almost a drop in the bucket compared to what we're doing today.

Q: The plant has been there since 1949. That's sixty years. Maybe the soils are different, but the PCP would still be there. That's 50-60 years to process.

A: The risk is based on levels of what might happen, not actually what did happen. A place could be using PCP for 60, 80, 100 years. Just because something happened there, doesn't mean it won't happen somewhere else. That's why we have to use our laboratory studies.

A: If you want to know what the effects of different chemicals are, we can get you copies of levels and effects of different chemicals.

Q: A few years ago, in Hopewell, a firm released a whole lot of Kepone into the James River. They said all the people working there were going to die. They had all kinds of things wrong with them. They closed the James River for fish, shellfish and crab. They're all still living there. Now 7-8 years later, its open to fish. Now, if you want to do some testing, why don't you test the people that have worked in this plant and handled it physically for 20 odd years, and see what effect it has had on them.

A: It may not effect whoever is working there. Risks are based on what might happen to a population. We're talking about one in one million and one in one hundred thousand who might actually get cancer.

A: And when you're talking about cancer, you're talking about a 25-30 year latency period, just like asbestos. Those people who worked with it, and then got cancer 30 years later. There's so much uncertainty.

Q: Why not test people who have worked with it?

A: The problem with testing people is that you have other outside factors- people who smoke, people who work in mines. They have a higher tendency for it. Some of the people have an hereditary effect that way. That's why we can't use testing people.

A: We're also not a health agency. We determine what the potential threat is. Another agency determines the effect on people that were around when the process was going on.

Q: Does anyone know what we're dealing with; in terms of contamination, in terms of a chemical, the effects, what it does. It's in the groundwater, and that's it? It's on the market and we don't know anything about it?

A: You can't just put a chemical on the market, anymore. It has to go by EPA. At the next public meeting, once we know the information, the nature and extent of contamination, we'll bring along a toxicologist.

Q: On other sites with soil contamination and groundwater, what happens to it? Does it dissipate? Does it stay there?

A: Basically, the range. Some off-site. On some, it stays there. Saunders has been helping to keep it there. They've been pumping out the groundwater, and reusing it back into the treatment system.

Q: I think people are asking, "What are the physical properties of PCP and our knowledge of the physical properties? Is it soluble, does it move, can it be transported? Is it a persistent chemical?"

A: PCP was used in an oil base and basically it stays in the oil, even in the water and the groundwater. Everything we're looking for is oil and grease. Increased levels of oil and grease may generate information on the levels of PCP.

Q: Have you indicated you've already made these studies at other sites? Have you completed them, and if so, what was your recommendation? What did you find?

A: The problem is, we don't know yet. That's why we're conducting the study.

A: At other sites, the tendency has been to take the soil and burn it off. As for the groundwater, we have to pump it out into a treatment system, and then discharge it back. In order to get it out. We don't want to be keyed into that. If there's a more economical, more sensible way, we'd rather do it.

Q: The city is already treating the water.

A: They're treating the water at a time. We're treating the water supply. The city would not want that responsibility for x number of years.

Q: I have been using water from these wells off and on for the last 10 years. In the last 5 years, I have noticed a decrease in the levels of PCP. W.R. Grace tests every 30 days. They're not picking up anything in the water. I've gone back to using these wells. But the State Water Control Board says if water goes through the soil, it'll pick (contaminants) back up. Is that possible that you know of?

A: Yes, the chemicals leach out of the soil into the groundwater.

Q: You say you're looking for oil and gas. With this oil spill at the gas station, couldn't the contamination be from a different source. The water runs across property lines, from that gas station.

A: The chemicals in the gas station are different from the chemicals in the PCP. The levels and properties of these chemicals are known. We have to identify how much is on the site. The rate at which they move through the soil depends on the particular site. Each site has to be studied. You have to take out the soil and look at it, and characterize it. When heavy metals are involved, it is much slower. It could take as many as ten years to move half a mile. Until we have enough information from the site, we cannot characterize the site. Someone can work in a factory and be exposed to a chemical but because of the rules of OSHA, be safe enough. But once the chemical gets into the environment, the effects are different. For instance, I can work with lead, and have no problems. But if I dump the lead into a river, or on a playground, and my children eat the soil in the playground, the effect on them will be very different. Also, organisms have the tendency to store the chemicals. We have to assure that on a longer term basis, it is safe. It is the responsibility of an accountable government to ensure that what is clean stays clean.

Q: If this treatment has been going on for 50 years, how many other sites in the State of Virginia have been tested and completed, and what effect has it had on the communities and the people, and what were your recommmendations? And how does EPA feel its smart enough to tell us what'll happen 25 years from now if you haven't been able to tell us on this point?

A: The Superfund program began only 9 years ago. They looked at what processes were going on that were wrong, and realized they needed to correct them. Once a site is reported, we begin with a Preliminary Assessment. And if these sites are a threat or potential threat to human health and the environment they are listed on the National Priorities List. In the State, there are 21 sites on the National Priorities List. About 1000 sites have been looked at. Some involve counties, and some involve private industries. Only one site has been delisted - completely cleaned up. Of the remaining twenty, the

sites are at different levels of action. The state is working to get the cleanup done. The longer they stay on the list, the more expensive they are. We do 50 investigations per year to determine if sites are serious enough for the National Priorities List.

Q: If you've done 50 investigations, how long does it take you to find out what is going on there. Is it bad or good?

A: We don't know how things are moving on this site, if at all. They're pumping up the groundwater. They may have trapped the plume from going off-site. It may not. That's what we have to find out. Then we can determine what the risk is.

A: There's only one other site in the Commonwealth, that's in Richmond. They're at the same stage as this one.

Q: If the Millpond is contaminated, how do you propose to get it out?

A: We haven't gotten that far. I don't know.

Q: Saunders Supply Company is doing the best they can. They dug out some of the soil, hauled it off, and put sand in it. What did they do with that dirt they dug up and hauled off in a truck?

A: It was placed in a landfill.

Q: Now you've got it in two places; in a landfill and over there. It doesn't matter where it is, if there's dirt and water, it'll get you.

A: We have a law called RCRA. We don't just create another problem by sticking the hazardous waste somewhere else. We have to treat it before we can dispose of it. Anything we do at Saunders will be treated so that it doesn't leach out.

Q: PCP has been used as a vegetative killer. Are you telling us that 20 years from now, you're going to come back to those farmers who have been using chemicals according to the labels, and tell us you've got a problem?

A: All pesticides have to be reviewed and approved by EPA.

Q: Twenty-five years ago, PCP as a vegetative killer was a labelled use. And it was also used in chicken houses as a termite killer.

Q: What scientific data do you have that it is a problem?

A: We don't know that there is a problem at the site. We know there is a potential problem. We know that the groundwater and the water in the pond may be contaminated now or in the future. We know chemicals have been found in the soil.

Q: After two years of testing, and you still don't know that there is a problem, what will be the cost of the study? How much taxpayers dollars will be spent in this RI/FS? How much is Ecology & Environment going to be paid?

A: Right now, in rough numbers, it will be $800,000 for the Remedial Investigation/Feasibility Study.

Q: But there is no scientific data that there is a problem?

A: There is a problem because there is a potential threat.
Q: You are going to pay for it?

A: It will be paid with Superfund monies.

Q: You won't bill anyone?

A: Before we began the study, we negotiated with the Saunders people about doing the study. They did a workplan and decided it was too much money for them at this time to do the study. That is why we're doing it with Superfund money. After this report, we'll go back to the Saunders people and say this is the recommended alternative if there is any. If Saunders can't pay for construction of the alternative, we'll again use Superfund money. At the end of all this, we'll again go back to Saunders under Cost Recovery and try to get money back on what we spent.

Q: Can you repeat that figure?

A: $800,000.

Q: You're spending $800,000 and its just a potential danger. You say $800,000 is not putting anyone out of business? Why don't you just buy Chuckatuck?

A: We're not going up to them tomorrow and saying you owe us $800,000.

Q: Hasn't Saunders Supply already spent alot of money?

A: Yes, it has. But the ironic thing about the Superfund law is that it makes people liable for what they did even if it was the best they knew how.

Q: What about us farmers? I'm using chemicals, but I'm using it according to labels. You're saying, according to Superfund, you could come after me.

A: EPA does not have a policy to go after farmers that are spraying their crops.

Q: Is this the only business in Virginia that was using this type of wood treating process? You're going after one individual company?

A: There are at least two other wood treating facilities on the National Priorities List. Both of those companies are paying for the studies themselves. There were quite a few other wood treatment facilities investigated. But they weren't serious enough a potential threat to human health and the environment to be put on the National Priorities

List. EPA looked at facilities with the most potential threat to the environment - wood treatment facilities and landfills.

Q: Our landfill was approved. But now we're being investigated as a city. We operated in good faith. We did what we were told to do by an agency. But again, we're having to spent taxpayers' dollars, just like Saunders Supply Company to do RI/FS studies. That's the way the law works. The congressmen and senators set it up, not these people.

Q: Saunders Supply Company has done everything possible. It's one of the cleanest operations I've ever seen. I've been involved with this site for 10 years. I don't know how anyone knows what's going on, when everytime you turn around, you have another group of people coming in. They're running around, doing the same tests over and over.

A: There has been a Preliminary Assessment. There has not been an in-depth study of the site. We are required by law to provide a permanent remedy - whether that means we do nothing, or we prepare an alternative to clean up the site, we are required by law to do that. We want to prevent a problem further down the road. We're here tonight to tell you there's a potential problem. Ten years from now, it could cost fifteen times as much to cleanup. There are alot of parties involved, but that's why Chris Jones is here tonight and the State. This is a coordinated effort.

Q: Why should individuals, or individual companies like Saunders, be penalized for using chemicals as stated on the label, when the chemical companies are the ones really doing the damage?

A: The law says to go after the owners, operators and the generators. We would rather go after the deep pockets. If we could go after someone else who could pay for the study, we would do that. We have an enforcement branch to go after these potentially responsible parties.

Q: If you give them a clean bill of health after this study is over, and 10 years from now something else comes up, what's going to happen?

A: We shouldn't miss that. That's why we're studying all different mediums.

A: We wouldn't have been doing our jobs very well. We'd have to go clean it up.

Q: And you'd get another $800,000.

A: It depends on Congress.

Q: If the salt treatment process being used now is according to labels, are you going to make them pay for a study to see what pollutants are going into the soil from a current labelled use?

A: Today the process is in a closed loop. The wood drips onto concrete pads, into a reservoir and back into the system. There is no sludge, no burning, nothing going off the site. Before they used a closed loop is the problem. It's not the chemicals, but the way it was allowed to get into the soil. It's a closed system now. There's nothing coming off the site now.

Q: The penta process smelt so bad we couldn't hang our clothes out to dry. They came back speckled and smelt like penta.

A: The problems were how the wood was allowed to dry, the use of an unlined earthen pond as a separator, that they burned some of the sludge.

Q: The closed loop was a required labelled practice back in 1974?

A: No, it's not the chemical, but how you use it. You can buy pesticide, but if you dump it in the creek, you're causing contamination. It's not the fact that you have it, but what you do with it.

Q: But the process wasn't illegal back then?

A: That's right.

Q: It still hasn't been stated how dangerous this is to people and how much they knew where it is. We still don't know how much danger we're in, how much danger we'll be in in 5 years. What is the purpose of the study if not to protect the persons of this community? How many buckets of dirt, or how many buckets of water will I have to drink before it will kill me? Isn't that the main purpose?

A: We will identify the risk associated with contamination of the site during the study.

A: We have a list of chemicals with contaminate levels for drinking waters. Contamination above those levels is an unacceptable risk. At this point, the water is safe. It's being tested and treated. The reason we're doing this study is to determine if there is a problem now or later on. It's not a quick and dirty study.

Q: You said you were just looking at PCP, copper, chromium, and arsenic. That's only four.

A: There are also others. From burning PCP, that could cause dioxin and furans. So that's two more things you have to look for.

Q: If you've done 30,000 investigations nationwide, at least one of those sites must be similar to this one. What have you found out?

A: Only 1000 of those 30,000 sites will have this type of investigation. I don't know how many of those are at this point. But as said before, they may have the same contaminants, but different soils, different media.

A: Of those 30,000, only a handful are wood treating facilities which are on the list and being investigated. Of those, most of them used creosote - for telephone, railroad ties. Most of our investigations have been those types of plants.

Q: Saunders Supply Company must have been an advanced corporation in 1964.

A: I'm not saying there has been only one. I'm saying the majority of wood treating facilities have been creosote.

Q: So we have no concrete answers to anything from other sites?

A: Yes, we do. We know that the best way to remove the contamination is to burn the soil.

Q: I hope what I eat doesn't make me sick. I have a garden in my backyard.

Q: I think these people are asking, "Do you have a base toxicological knowledge of these contaminants? Do you know in general what these contaminants can do to you, not in relation to the site."

A: From studies of pentachlorophenol, we have some base knowledge of how it effects humans. We have knowledge of how chromium, copper and arsenic affect humans, at what levels. What we have to do at this site is put an exposure scenario together. We determine what is the exposure to the average citizen, to the average worker. Then we look at our toxicological base knowledge and apply it to the site. Then we calculate the risk. And that's how the risk assessment is done. When we come back to you, we'll be able to say, from this site, drinking the water will pose this risk, inhaling the dirt will pose another risk, ingesting the dirt, 2 ounces in your mouth over 70 years will pose this risk, over one week will pose this risk. We'll have all those answers for you. We don't have those answers right now.

Q: You ought to have an answer from the people who have been dealing with it for 25 years and the next door neighbors.

A: There are two types of studies. There are toxicological studies, which are what we do, which is to find out what risk is posed. What you're referring to is an epidemiological study which is the effects of workers at the site over a long period of time. We are not a health agency. The Agency for Toxic Substances and Disease Registry do the health effects. They have a coordinator in our office, and ATSDR looks at these sites and they determine through our investigations, through our sampling that the site warrants a health study. They'll come in and look at it. They can't tell if it's warranted right now, and we start taking samples and find out just how bad the contaminants are at this site. We don't have the answers on risks right now.

Q: If you're not a health agency, how are you going to tell us how it'll affect us 10 years from now?

A: Through a risk study, which is all probabilities. You may have a one in 10 or one in one million, or one in one billion probability of getting cancer.

Q: For $800,000, it doesn't sound reasonable.

A: I can understand that, but our science is limited.

Q: Did you say that the best way to take care of contaminated soil is to burn it?

A: On other sites, they determined that.

Q: What happens to the air space with burning it?

A: It's burned in a controlled, safe way. And you'll have an opportunity to comment on it.

Q: How long is the study?

A: We're estimating 18 months.

Q: I am an attorney working for Saunders Supply Company. I'd like to clarify that the EPA has proposed putting Saunders Supply Company on the National Priorities List. The site is not on the final National Priorities List. The company has filed comments raising questions on two occasions on how the risks have been calculated from the outset. It is not a foregone conclusion that anyone needs to be out there. People talk about it as being on the National Priorities List, and something will have to be done. I hope I did not hear EPA saying that this site is on the final NPL.

A: The site is proposed for the National Priorities List. It's a two step process. Once a site is ranked, and it reaches a certain ranking (a mathematical ranking), it's proposed for the National Priorities List. For a period of time, it's put up for public comment as to why it should or should not be on this prestigious National Priorities List. If, after all the comments have been received, we still believe it belongs on the National Priorities List, we actually put it on the National Priorities List. That has not happened yet. What we do in the meantime at the proposed stage, is start our study so we're not hanging around for years waiting for public comment. We're out there trying to determine if there's a problem, so we don't waste a year in between. We cannot start an action while the site is still proposed, by law. We have to wait for the site to be promulgated on the National Priorities List. But we can take samples, develop alternatives, and even select and design a remedy. But we can't spend money. The big ticket is the remedial work. $800,000 is a drop in the bucket.

We have a small firm here. Most sites have big chemical oil companies that EPA goes after. They negotiate and either cleanup or EPA cleans up. We offer small companies these same opportunities. They operated in good faith. They negotiated. They couldn't pay for it. The site was turned over to the Superfund side of EPA. So we'll start the investigation.

Q: Will they have to pay for the cleanup if you decide it has to be cleaned up?

A: When we decide what needs to be done, if there is some cleanup involved, we'll go back to Saunders and say this is what we'll do. Saunders and others comment. If Saunders cannot pay, we'll use Superfund money and implement the remedy. Another EPA group gets involved. They see how much we've spent at the site, the financial capabilities of the potentially responsible parties, and then decide what they'll bill the company for that cleanup. That is the Cost Recovery action part of EPA.

Q: If you come back and say there's one in 750,000 chance somebody is going to get cancer, and that's unacceptable and has to be cleaned up, and everyone in the community says we don't want it, then that doesn't matter? You're going to clean it up anyway?

A: If we get strong public opposition for the right reasons, then we'll change the remedy. We'll have to take another look at it. We come out with a proposed plan, and ask you what you think about it.

A: The law also requires that we select a remedy that is cost effective.

Q: Why are you picking on Saunders? Why don't you pick on the chemical company that produced?

A: It is not the chemical that caused the problem. It is the waste disposal. They may have operated in the best manner possible. But Superfund is blind to that. It says there is a problem, and we have to clean it up.

Q: I've been here two hours and haven't heard a single fact on what the effect is or how much you have to be exposed to it.

A: Our information is limited.

Q: What if you dig a well in the exact spot of an old post hole, and the contamination is actually from the treated post?

A: The chemical may be different on the post. We're also digging other wells.

Q: Of everyone that's come here about the site, I've never seen the same one twice. How can you have good information?

A: As your councilman, I will act as the go-between.

Q: If a site has been proposed, and all the investigative work is done, and you determine not to put it on the final list, can you initiate cost recovery?

A: We will follow up on that question (see Note).

Q: What has happened to the eight years of studies - Saunders and the State Water Control Board have done a number of tests?

A: We have used that information to come up with the Workplan. All that data was used. Once you get involved in it, it takes a long time. You have to decide what you're going to do, then you have to go out and do it, and the time to do the sampling and have it quality checked, and then evaluate the results.

Q: You're saying 18 months and the EPA man that was here in December said 2-5 years.

A: The workplan hadn't been finalized then. Also, when we say 18 months, you have to give or take a few months. For example, if the contamination has extended further, the study will take longer.

Q: For $800,000, we could use studies we have and take the whole site over the South Carolina line.

A: Legally, we're not allowed to do that.

A: If you're frustrated with Superfund, we suggest writing your Congressman. That's your opportunity to comment on the program, now that its touching you personally.

Q: How long have you people been connected with this particular project?

A: The Community Relations Program starts up when the Remedial Investigation begins, so I've been on it one month. The project manager has been with it 6 months.

A: The Enforcement Branch did the earlier negotiations with Saunders. Once it was determined that Saunders could not afford to do the study, it came over to the Superfund section.

Q: The man who came in December asked me if i trusted EPA, and I said I would unless they told me something that wasn't true. I guess that's why he's not here tonight.

A: Bill Draper is still working for EPA, but he's working on a site in California.

* Note: To date, EPA has not pursued cost recovery at sites where no further action is required after the RI/FS. However, the law does permit EPA to sue for all costs incurred.

Q: If the site is not on the Superfund list, why does the newspaper say it is on the list?

A: I don't know. The proposed and final list of sites are often treated the same way.

Q: Didn't the newspaper get their information from you?

A: Yes, it did. But our news release says that the site is on the proposed list. I will give you a copy of the new release after the meeting so you can see for yourself.

Attachment C

MAILING LIST

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S. Chris Jones	8978 River Crescent Dr. Suffolk, VA 23433	238-3667

APPENDIX B

SOIL BORINGS AND MONITORING WELLS

SOIL BORINGS

DRILLING LOG of BORING No. B-1

State	Virginia	Start Date	7/11/89
Location	Chuckatuck	Completion Date	7/13/89
Drilling Firm	GES Inc.	Ground Elevation	45.23
Type of Drill	CME 55	Total Depth of Boring	8.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
45.23		Ground Surface				
45		0.0-0.5: SAND (SW): gray, translucent, fine grained, 2" topsoil		1	5 8	HSA with split spoons for sampling
	1	0.5-1.0: SAND (SW): dark gray and locally black, fine grained			3	SS Run 1: 0.0-2.0
	2			2	2 6	1.83/2.0 recovery Sample from 0.0-2.0
	3	1.0-2.1: SAND (SW): brownish white, fine grained			5	PCP/TPH
		2.1-5.5: SAND (SW): brown, fine grained, wet at bottom			4	OVA: 0ppm on spoon
	4				4	0ppm in hole
				3	1	SS Run 2: 2.0-4.0
	5				2	1.83/2.0 recovery
40					3	Sample from 2.0-4.0
	6				2	PCP/TPH
				4	1	OVA: 0ppm on spoon
	7	5.5-8.0: CLAYEY SAND (SC): brown, locally silty (@10%). @20% clay			2	0ppm in hole
					2	SS Run 3: 4.0-6.0
	8				9	1.83/2.0 recovery
						Sample from 4.0-6.0
						PCP/TPH
						OVA: 0ppm on spoon
						0ppm in hole
						SS Run 4: 6.0-8.0
						1.67/2.0 recovery
						OVA: 0ppm on spoon
						0ppm in hole

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DRILLING LOG of BORING No. CB-1

State	Virginia	Start Date	7/20/89
Location	Chuckatuck	Completion Date	7/20/89
Drilling Firm	GES Inc.	Ground Elevation	44.40
Type of Drill	CME 55	Total Depth of Boring	10.0'
Driller	D Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
44.40		Ground Surface				
		0.0-0.5: GRAVEL (GW): road gravel		1	4	HSA with split spoons for sampling
	1	0.5-1.5: SAND (SW): brown, medium grained			5	
					8	SS Run 1: 0.0-2.0
	2	1.5-2.2: SAND (SW/SC): same as above with oily black clayey sand (20%)			10	1.83/2.0 recovery
				2	3	Sample from 0.0-2.0
	3	2.2-5.9: SAND (SP): gray, medium to fine grained, moist			6	PCP/TPH
					5	OVA: 0ppm on spoon
	4				6	0ppm in hole
40				3	2	SS Run 2: 2.0-4.0
	5				1	1.83/2.0 recovery
					8	Sample from 2.0-4.0
	6				11	PCP/TPH
		5.9-6.4: CLAYEY SAND (SC): gray, 30% clay		4	4	OVA: 0ppm on spoon
	7				4	0ppm in hole
		6.4-8.1: SAND (SP): gray, medium to fine grained			1	SS Run 3: 4.0-6.0
	8				1	1.83/2.0 recovery
		8.1-10.0: CLAY (CL): black, marshy, trace of wood		5	4	Sample from 4.0-6.0
	9				1	PCP/TPH
35					1	OVA: 0ppm on spoon
	10	9.75-10.0: same as above, but silty (20% silt)			2	0ppm in hole
						SS Run 4: 6.0-8.0
						1.67/2.0 recovery
						OVA: 0ppm on spoon
						0ppm in hole
						SS Run 5: 8.0-10.0
						1.83/2.0 recovery
						OVA: 0ppm on spoon
						0ppm in hole

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DRILLING LOG of BORING No. CB-2

State	Virginia	Start Date	7/27/89
Location	Chuckatuck	Completion Date	7/27/89
Drilling Firm	GES Inc.	Ground Elevation	42.20
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
42.20		Ground Surface				
		0.0-0.5: TOPSOIL: black		1	2	HSA with split spoons for sampling
	1	0.5-1.5: SAND (SP): medium to fine grained			1	SS Run 1: 0.0-2.0
					2	1.83/2.0 recovery
40	2	1.5-2.25: SAND (SP): gray black, medium to fine grained			3	Sample from 0.0-2.0
				2	2	PCP/TPH
	3	2.25-6.0: SAND (SP/SM): white to gray, sparse orange, medium to fine grained with locally slightly silty			1	OVA: 0ppm on spoon
					1	2ppm in hole
	4			3	1	SS Run 2: 2.0-4.0
					3	1.83/2.0 recovery
	5				1	Sample from 2.0-4.0
					1	PCP/TPH
	6				2	OVA: 0ppm on spoon
						2ppm in hole
						SS Run 3: 4.0-6.0
						1.83/2.0 recovery
						Sample from 4.0-6.0
						PCP/TPH
						OVA: 0ppm on spoon
						2ppm in hole

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DRILLING LOG of BORING No. CB-4 Page 1 of 1

State Virginia Start Date 7/27/89

Location Chuckatuck Completion Date 7/27/89

Drilling Firm GES Inc. Ground Elevation 41.80

Type of Drill CME 55 Total Depth of Boring 6.0'

Driller D. Pugh

Geologist A. Ayuboha

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
41.80		Ground Surface				
		0.0-1.0: TOPSOIL: black, sandy		1	2	HSA with split spoons for sampling
	1				3	
		1.0-3.0: SAND (SP): gray and tan, medium to fine grained			1	SS Run 1: 0.0-2.0 1.83/2.0 recovery
40	2				4	
				2	1	Sample from 0.0-2.0 PCP/TPH
	3				2	
		3.0-5.0: SAND (SW): grayish white, medium grained, wet			1	OVA: 0ppm on spoon 0ppm in hole
	4				1	
				3	2	SS Run 2: 2.0-4.0 1.83/2.0 recovery
	5				3	
					4	Sample from 2.0-4.0 PCP/TPH
	6				5	OVA: 0ppm on spoon 5ppm in hole
						SS Run 3: 4.0-6.0 1.83/2.0 recovery
						Sample from 4.0-6.0 PCP/TPH
						OVA: 0ppm on spoon 7ppm in hole

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DRILLING LOG of BORING No. CB-5

Page 1 of 1

State	Virginia	Start Date	7/27/89
Location	Chuckatuck	Completion Date	7/27/89
Drilling Firm	GES Inc.	Ground Elevation	41.80
Type of Drill	CME 55	Total Depth of Boring	4.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
41.80		Ground Surface				
		0.0-0.8: SAND (SM): black sand and topsoil		1	2	HSA with split spoons for sampling
	1				4	
		0.8-4.0: SAND (SP): tan, medium to fine grained			3	SS Run 1: 0.0-2.0 1.83/2.0 recovery
40	2				3	
				2	3	Sample from 0.0-2.0 PCP/TPH
	3				1	
					1	OVA: 0ppm on spoon 2ppm in hole
	4				4	
						SS Run 2: 2.0-4.0 1.83/2.0 recovery
						Sample from 2.0-4.0 PCP/TPH
						OVA: 0ppm on spoon 0ppm in hole

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DRILLING LOG of BORING No. CB-6 Page 1 of 2

State	Virginia	Start Date	7/27/89
Location	Chuckatuck	Completion Date	7/27/89
Drilling Firm	GES Inc.	Ground Elevation	42.30
Type of Drill	CME 55	Total Depth of Boring	14.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
42.30		Ground Surface				
	1	0.0-1.0: SAND (SM): black sand and topsoil		1	3 4	HSA with split spoons for sampling
	2	1.0-3.0: SAND (SP): tan, medium to fine grained			4 3	SS Run 1: 0.0-2.0 1.83/2.0 recovery
40				2	2 2	Sample from 0.0-2.0 PCP/TPH
	3					
	4	3.0-4.0: SAND/SANDY CLAY (SM/CL): tan, silty (20%) and 20% sandy clay, wet			3 4	OVA: 0ppm on spoon 1ppm in hole
	5	4.0-7.0: SAND (SP/SM): tan, wet, medium grained with locally silty sand (<20%), slightly compact		3	4 7 6	SS Run 2: 2.0-4.0 1.83/2.0 recovery Sample from 2.0-4.0
	6				6	PCP/TPH
				4	2	OVA: 0ppm on spoon
	7				3	2ppm in hole
35		7.0-8.75: CLAY (CL): gray, silty			1	SS Run 3: 4.0-6.0
	8				3	1.83/2.0 recovery
				5	6	Sample from 4.0-6.0
	9				6	PCP/TPH
		8.75-13.0: SAND (SP): gray, medium to coarse grained			7	OVA: 0ppm on spoon
	10				10	0ppm in hole
				6	3	SS Run 4: 6.0-8.0
	11				1	1.83/2.0 recovery
					1	OVA: 0ppm on spoon
	12				1	0ppm in hole
30				7	7	SS Run 5: 8.0-10.0
	13				7	1.83/2.0 recovery
		13.0-14.0: CLAY (CL): dark bluish gray			3	OVA: 0ppm on spoon
	14				4	0ppm in hole
						SS Run 6: 10.0-12.0 1.83/2.0 recovery OVA: 0ppm in hole 0ppm in hole

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DRILLING LOG of BORING No. CB-6 Page 2 of 2

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
						SS Run 7: 12.0-14.0 1.83/2.0 recovery OVA: Oppm on spoon Oppm in hole Moved 2ft: Augered to obtain Shelby Tube sample from 13.0-15.0

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DRILLING LOG of BORING No. KF-1

State	Virginia	Start Date	7/26/89
Location	Chuckatuck	Completion Date	7/26/89
Drilling Firm	GES Inc.	Ground Elevation	40.80
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
40.80		Ground Surface				
40	1	0.0-2.0: SAND (SW): black sand and topsoil		1	1 1 2 2	HSA with split spoons for sampling SS Run 1: 0.0-2.0 1.83/2.0 recovery
	2	2.0-6.0: SAND (SW): gray-orange, medium grained		2	2 2 2 2	Sample from 0.0-2.0 PCP/TPH OVA: 0ppm on spoon 40-50ppm in hole
	3					
	4			3	1 2 2 2	SS Run 2: 2.0-4.0 1.5/2.0 recovery Sample from 2.0-4.0 PCP/TPH OVA: 0ppm on spoon 4-6ppm in hole SS Run 3: 4.0-6.0 1.5/2.0 recovery Sample from 4.0-6.0 PCP/TPH OVA: 3-4ppm on spoon 10ppm in hole
	5					
35	6					

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DRILLING LOG of BORING No. KF-2

State	Virginia	Start Date	9/20/89
Location	Chuckatuck	Completion Date	9/26/89
Drilling Firm	GES Inc.	Ground Elevation	37.64
Type of Drill	CME 55	Total Depth of Boring	26.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
37.64		Ground Surface				
	0	0.0-1.0: SAND (SM): black sand and topsoil		1	3	HSA with split spoons
	1				5	for sampling
		1.0-2.0: SAND (SP): white, medium to fine grained, wet			5	SS Run 1: 0.0-2.0
	2				4	1.83/2.0 recovery
35		2.0-6.0: SAND and CLAYEY SAND (SP/SC): brownish gray, compact sand and clayey sand (<20%)		2	3	Sample from 0.0-2.0
	3				5	PCP/TPH
					5	OVA: 0ppm on spoon
	4				6	0ppm in hole
				3	2	SS Run 2: 2.0-4.0
	5				4	1.83/2.0 recovery
					4	Sample from 2.0-4.0
	6				6	PCP/TPH
		6.0-9.5: SAND (SW): tan, coarse grained		4	2	OVA: 0ppm on spoon
	7				2	0ppm in hole
30					3	SS Run 3: 4.0-6.0
	8				6	1.83/2.0 recovery
				5	3	Sample from 4.0-6.0
	9				4	PCP/TPH
					6	OVA: 0ppm on spoon
	10	9.5-10.3: SAND (SP): tan and gray, fine grained, locally silty (@10%) and clayey (@10%)			9	0ppm in hole
				6	3	SS Run 4: 6.0-8.0
	11				4	1.83/2.0 recovery
		10.3-13.0: SAND (SW): brownish white, medium grained, wet			7	OVA: 0ppm on spoon
	12				5	0ppm in hole
25				7	2	SS Run 5: 8.0-10.0
	13				2	1.83/2.0 recovery
		13.0-13.5: same as above with rusty iron-rich staining			3	OVA: 0ppm on spoon
	14	13.5-14.0: CLAY (CL): greenish gray, stiff			4	0ppm in hole
						SS Run 6: 10.0-12.0
						1.83/2.0 recovery
						OVA: 0ppm on spoon
						0ppm in hole

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DRILLING LOG of BORING No. KF-2

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
						SS Run 7: 12.0-14.0 1.83/2.0 recovery OVA: 0ppm on spoon 0ppm in hole

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DRILLING LOG of BORING No. KE-3

State	Virginia	Start Date	7/26/89
Location	Chuckatuck	Completion Date	7/26/89
Drilling Firm	GES Inc.	Ground Elevation	38.30
Type of Drill	CME 55	Total Depth of Boring	8.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
38.30		Ground Surface				
		0.0-0.5: SAND (SM): sand and black topsoil		1	1	HSA with split spoons for sampling
	1	0.5-4.1: SAND (SP/SC): brown and orange with locally clayey sand (10%)			3	SS Run 1: 0.0-2.0
					4	1.83/2.0 recovery
	2				5	Sample from 0.0-2.0
				2	2	PCP/TPH
	3				3	OVA: 0ppm on spoon
35					4	0ppm in hole
	4				6	
		4.1-8.0: SAND (SM): grayish white, medium grained with layers of silty (10%), clayey (10%) sand		3	5	SS Run 2: 2.0-4.0
	5				5	1.83/2.0 recovery
					5	Sample from 2.0-4.0
	6				7	PCP/TPH
				4	3	OVA: 0ppm on spoon
	7				2	0ppm in hole
					3	SS Run 3: 4.0-6.0
	8				4	1.83/2.0 recovery
						Sample from 4.0-6.0
						PCP/TPH
						OVA: 0ppm on spoon
						0ppm in hole
						SS Run 4: 6.0-8.0
						1.83/2.0 recovery
						OVA: 0ppm on spoon
						0ppm in hole

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DRILLING LOG of BORING No. KF-4

State	Virginia	Start Date	7/26/89
Location	Chuckatuck	Completion Date	7/26/89
Drilling Firm	GES Inc.	Ground Elevation	40.10
Type of Drill	CME 55	Total Depth of Boring	10.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
40.10		Ground Surface				
40		0.0-0.6: SAND (SM): dark gray sand with topsoil		1	5	HSA with split spoons for sampling
	1	0.6-2.0: SAND (SP): gray, medium to fine grained			5	SS Run 1: 0.0-2.0
					5	1.83/2.0 recovery
	2				2	Sample from 0.0-2.0
		2.0-3.0: SAND (SP): tan and orange, medium to fine grained		2	3	PCP/TPH
	3				3	OVA: 0ppm on spoon
		3.0-10.0: SAND (SP): grayish white, medium to fine grained, brown and wet at the bottom			4	0ppm in hole
	4				5	SS Run 2: 2.0-4.0
				3	3	1.83/2.0 recovery
35	5				4	Sample from 2.0-4.0
					5	PCP/TPH
	6				5	OVA: 0ppm on spoon
				4	4	0ppm in hole
	7				4	SS Run 3: 4.0-6.0
					5	1.83/2.0 recovery
	8				2	Sample from 4.0-6.0
				5	5	PCP/TPH
	9				4	OVA: 0ppm on spoon
					5	0ppm in hole
	10				4	SS Run 4: 6.0-8.0
						1.83/2.0 recovery
						OVA: 0ppm on spoon
						0ppm in hole
						SS Run 5: 8.0-10.0
						1.83/2.0 recovery
						OVA: 0ppm on spoon
						0ppm in hole

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DRILLING LOG of BORING NO. KF-5

State	Virginia	Start Date	7/15/89
Location	Chuckatuck	Completion Date	7/15/89
Drilling Firm	GES Inc.	Ground Elevation	35.40
Type of Drill	CME 55	Total Depth of Boring	18.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
35.40		Ground Surface				
35		0.0-1.0: SAND (SP): brown, locally black, medium to fine grained		1	3	HSA with split spoons for sampling
	1				2	
		1.0-9.0: SAND (SP): brown and white, medium to fine grained			2	SS Run 1: 0.0-2.0
	2				1	1.83/2.0 recovery
				2	4	Sample from 0.0-2.0
	3				3	PCP/TPH
					3	OVA: 0ppm on spoon
	4				4	0ppm in hole
				3	2	SS Run 2: 2.0-4.0
	5				3	1.83/2.0 recovery
30					4	Sample from 2.0-4.0
	6				3	PCP/TPH
				4	3	OVA: 0ppm on spoon
	7				3	0ppm in hole
					5	SS Run 3: 4.0-6.0
	8				8	1.83/2.0 recovery
				5	3	Sample from 4.0-6.0
	9				2	PCP/TPH
		9.0-10.0: CLAYEY SILTY SAND (SM-SC): brownish gray, 20% clay, 20% silt			2	OVA: 0ppm on spoon
	10				3	0ppm in hole
25		10.0-13.0: SAND (SW): brown, coarse grained, very coarse grained at bottom, trace of black organics		6	1	SS Run 4: 6.0-8.0
	11				1	1.83/2.0 recovery
					1	OVA: 0ppm on spoon
	12				1	0ppm in hole
				7	2	SS Run 5: 8.0-10.0
	13				2	1.83/2.0 recovery
		13.0-13.5: SAND (SW): brown, rusty, iron-rich, coarse grained			2	OVA: 0ppm on spoon
	14				3	0ppm in hole
				8	3	SS Run 6: 10.0-12.0
	15	13.5-17.5: CLAYEY SILT (ML): gray, 20% clay, 20% sandy clay			2	1.83/2.0 recovery
20					3	OVA: 0ppm on spoon
					4	0ppm in hole

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DRILLING LOG of BORING No. KF-5 Page 2 of 2

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
				9	4	SS Run 7: 12.0-14.0
	17				4	1.83/2.0 recovery
					4	OVA: Oppm on spoon
	18	17.5-18.0: SILTY SAND (SM): gray with white shell fragments			8	Oppm in hole
						SS Run 8: 14.0-16.0
						1.83/2.0 recovery
						OVA: Oppm on spoon
						Oppm in hole
						SS Run 9: 16.0-18.0
						1.83 recovery
						OVA: Oppm on spoon
						Oppm in hole

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DRILLING LOG of BORING No. PA-1

State	Virginia	Start Date	7/18/89
Location	Chuckatuck	Completion Date	7/18/89
Drilling Firm	GES Inc.	Ground Elevation	42.20
Type of Drill	CME 55	Total Depth of Boring	8.0'
Driller	D Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
42.20		Ground Surface				
		0.0-0.5: GRAVEL (GW): road gravel		1	9	HSA with split spoons
	1	0.5-5.5: SAND (SP): tan, medium to fine grained			13	for sampling
		darker from 0.5-0.75 ft			16	SS Run 1: 0.0-2.0
40	2				15	1.5/2.0 recovery
				2	4	Sample from 0.0-2.0
	3				6	PCP/TPH
					7	OVA: Oppm on spoon
	4				8	Oppm in hole
				3	4	SS Run 2: 2.0-4.0
	5				7	1.67/2.0 recovery
					6	Sample from 2.0-4.0
	6	5.5-8.0: SAND (SW): light gray to white, medium			7	PCP/TPH
		grained		4	4	OVA: Oppm on spoon
					8	Oppm in hole
35	7				15	SS Run 3: 4.0-6.0
	8				12	1.75/2.0 recovery
						Sample from 4.0-6.0
						PCP/TPH
						OVA: Oppm on spoon
						Oppm in hole
						SS Run 4: 6.0-8.0
						1.83/2.0 recovery
						OVA: Oppm on spoon
						Oppm in hole

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DRILLING LOG of BORING No. PA-2

State: Virginia — Start Date: 7/18/89

Location: Chuckatuck — Completion Date: 7/19/89

Drilling Firm: GES Inc. — Ground Elevation: 43.82

Type of Drill: CME 55 — Total Depth of Boring: 16.0'

Driller: D Pugh

Geologist: A. Ayuboha

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
43.82		Ground Surface				
		0.0-0.5: GRAVEL (GW): road gravel		1	11	HSA with split spoons
	1	0.5-2.0: SAND (SP): black, medium to fine grained			18	for sampling
					18	SS Run 1: 0.0-2.0
	2				12	1.83/2.0 recovery
		2.0-7.0: SAND (SW): tan, medium grained		2	10	Sample from 0.0-2.0
	3				8	PCP/TPH
					5	OVA: 0ppm on spoon
40	4				8	3ppm in hole
				3	8	SS Run 2: 2.0-4.0
	5				6	1.83/2.0 recovery
					6	Sample from 2.0-4.0
	6	5.6-7.0: same as above but wet			5	PCP/TPH
				4	12	OVA: 0ppm on spoon
	7				7	0ppm in hole
		7.0-9.5: SAND (SW): white to light grey, wet, medium grained			8	SS Run 3: 4.0-6.0
	8				11	1.83/2.0 recovery
				5	10	Sample from 4.0-6.0
35	9				5	PCP/TPH
					1	OVA: 0ppm on spoon
	10	9.5-10.0: SAND (SW): rusty orange, medium grained			1	0ppm in hole
		10.0-13.0: CLAY (CL): grayish black, locally marshy				SS Run 4: 6.0-8.0
	11					1.83/2.0 recovery
						OVA: 0ppm on spoon
	12					0ppm in hole
				6	10	SS Run 5: 8.0-10.0
	13				6	1.83/2.0 recovery
		13.0-15.0: SAND (SW): greenish, medium grained			3	OVA: 0ppm on spoon
30	14				2	1ppm in hole
				7	3	Auger: 10.0-12.0
	15				2	OVA: 1ppm in hole
		15.0-16.0: CLAY (CL): greenish with similar texture to black clay in B-1			2	SS Run 6: 12.0-14.0
					4	1.83/2.0 recovery

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DRILLING LOG of BORING No. PA-2 Page 2 of 2

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
						OVA: 0ppm on spoon 1ppm in hole SS Run 7: 14.0-16.0 1.83/2.0 recovery OVA: 0ppm on spoon 2ppm in hole Moved 2ft: Augered from 0.0-15.0 to to obtain Shelby Tube Sample from 15.0-17.0

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DRILLING LOG of BORING No. PA-3

State	Virginia	Start Date	7/18/89
Location	Chuckatuck	Completion Date	7/18/89
Drilling Firm	GES Inc.	Ground Elevation	44.30
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
44.30		Ground Surface				
		0.0-0.5: GRAVEL (GW): road gravel		1	7	HSA with split spoons
	1	0.5-0.9: SAND (SW): black, medium grained			8	for sampling
					10	SS Run 1: 0.0-2.0
	2	0.9-2.0: SAND (SP): tan, medium to fine grained			10	1.75/2.0 recovery
		2.0-4.0: SAND (SW): light gray to white, medium		2	4	Sample from 0.0-2.0
	3	grained, wet at bottom			4	PCP/TPH
					2	OVA: 0ppm in hole
	4				4	SS Run 2: 2.0-4.0
40		4.0-6.0: SAND (SW): tan, medium grained, wet		3	4	1.67/2.0 recovery
	5				4	Sample from 2.0-4.0
					5	PCP/TPH
	6				6	OVA: 0ppm in hole
						SS Run 3: 4.0-6.0
						1.5/2.0 recovery
						Sample from 4.0-6.0
						PCP/TPH
						OVA: 0ppm in hole

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DRILLING LOG of BORING No. ST-1

State	Virginia	Start Date	7/21/89
Location	Chuckatuck	Completion Date	7/22/89
Drilling Firm	GES Inc.	Ground Elevation	45.26
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
45.26		Ground Surface				
45		0.0-0.5: GRAVEL (GW): road gravel		1	9	HSA with split spoons for sampling
	1	0.5-1.0: SAND (SW): dark gray, medium grained			10	
		1.0-2.5: SAND (SP): yellow to tan, medium to fined grained			12	SS Run 1: 0.0-2.0 1.83/2.0 recovery
	2				7	
				2	3	Sample from 0.0-2.0 PCP/TPH
	3	2.5-6.0: SAND (SP): light gray to white fine grained sand with trace tan, medium grained sand			5	OVA: 0ppm on spoon 0ppm in hole
					4	
	4				5	
				3	2	SS Run 2: 2.0-4.0 1.83/2.0 recovery
	5				1	
40					2	Sample from 2.0-4.0 PCP/TPH
	6				2	OVA: 0ppm on spoon 0ppm in hole
						SS Run 3: 4.0-5.0 1.0/2.0 recovery
						Sample from 4.0-6.0 PCP/TPH
						OVA: 0ppm on spoon 0ppm in hole

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DRILLING LOG of BORING No. ST-2

State: Virginia
Location: Chuckatuck
Drilling Firm: GES Inc.
Type of Drill: CME 55
Driller: D. Pugh
Geologist: A. Ayuboha
Start Date: 7/24/89
Completion Date: 7/24/89
Ground Elevation: 45.90
Total Depth of Boring: 6.0'

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
45.90		Ground Surface				
		0.0-0.5: GRAVEL (GW): road gravel		1	7	HSA with split spoons for sampling
45	1	0.5-3.6: SAND (SP): tan with trace of darker areas, medium to fine grained			8	
					7	SS Run 1: 0.0-2.0
	2				7	1.83/2.0 recovery
				2	3	Sample from 0.0-2.0
	3				5	PCP/TPH
					4	OVA: Oppm on spoon
	4	3.6-4.0: SAND (SP): brown			5	Oppm in hole
		4.0-6.0: SAND (SW): white, gray, clear, medium grained		3	2	SS Run 2: 2.0-4.0
	5	wet from 4-5 ft.			3	1.83/2.0 recovery
					4	Sample from 2.0-4.0
40	6				5	PCP/TPH
						OVA: Oppm on spoon
						Oppm in hole
						SS Run 3: 4.0-6.0
						1.83/2.0 recovery
						Sample from 4.0-6.0
						PCP/TPH
						OVA: Oppm on spoon
						Oppm in hole

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DRILLING LOG of BORING No. ST-3

State	Virginia	Start Date	7/21/89
Location	Chuckatuck	Completion Date	7/21/89
Drilling Firm	GES Inc.	Ground Elevation	44.80
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
44.80		Ground Surface				
		0.0-0.5: GRAVEL (GW): road gravel		1	11	HSA with split spoons for sampling
	1	0.5-6.0: SAND (SP): gray, medium to fine grained			16	
					15	SS Run 1: 0.0-2.0
	2				12	1.83/2.0 recovery
				2	3	Sample from 0.0-2.0
	3				5	PCP/TPH
					6	OVA: 0ppm on spoon
	4				2	0ppm in hole
				3	3	SS Run 2: 2.0-4.0
40	5				2	1.83/2.0 recovery
					1	Sample from 2.0-4.0
	6				1	PCP/TPH
						OVA: 0ppm on spoon
						0ppm in hole
						SS Run 3: 4.0-6.0
						0.83/2.0 recovery
						Sample from 4.0-6.0
						PCP/TPH
						OVA: 0ppm on spoon
						0ppm in hole

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DRILLING LOG of BORING No. WP-1

State	Virginia	Start Date	7/24/89
Location	Chuckatuck	Completion Date	7/24/89
Drilling Firm	GES Inc.	Ground Elevation	42.90
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
42.90		Ground Surface				
		0.0-0.3: TOPSOIL: black sand and topsoil		1	2	HSA with split spoons for sampling
	1				2	
		0.3-3.0: SAND (SP): dark gray, medium to fine grained			3	SS Run 1: 0.0-2.0 1.83/2.0 recovery
	2				4	
				2	2	Sample from 0.0-2.0 PCP/TPH
40	3					OVA: 0ppm on spoon 0ppm in hole
		3.0-4.0: SAND (SM/SC): black, fine grained sand with clayey sand (20%), oily				
	4					
		4.0-6.0: SAND (SW): grayish white, medium grained		3	3	SS Run 2: 2.0-4.0 1.83/2.0 recovery
	5					Sample from 2.0-4.0 PCP/TPH
						OVA: 0ppm on spoon 0ppm in hole
	6					SS Run 3: 4.0-6.0 1.83/2.0 recovery
						Sample from 4.0-6.0 PCP/TPH
						OVA: 0ppm on spoon 0ppm in hole

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DRILLING LOG of BORING No. WP-2

State	Virginia	Start Date	7/26/89
Location	Chuckatuck	Completion Date	7/26/89
Drilling Firm	GES Inc.	Ground Elevation	37.00
Type of Drill	CME 55	Total Depth of Boring	8.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
37.00		Ground Surface				
	1	0.0-1.25: SAND (SM): black sand and topsoil		1	5 6	HSA with split spoons for sampling
35	2	1.25-2.9: SAND/GRAVEL: (SP/GP): very coarse grained sand with large quartz pebbles (20%)		2	4 3 1 5	SS Run 1: 0.0-2.0 1.83/2.0 recovery Sample from 0.0-2.0 PCP/TPH
	3				6	
	4	2.9-5.8: SAND (SP): dark gray, medium to fine grained		3	2 3 2 2 5	OVA: 0ppm on spoon 0ppm in hole SS Run 2: 2.0-4.0 1.83/2.0 recovery Sample from 2.0-4.0 PCP/TPH
	5					
	6				6	
		5.8-6.9: SAND/GRAVEL (SP/GP): very coarse grained sand with quartz pebbles (20%)		4	1	OVA: 0ppm on spoon 0ppm in hole
30	7				1 3	SS Run 3: 4.0-6.0 1.83/2.0 recovery
	8	6.9-8.0: SAND (SW): coarse to very coarse grained			2	Sample from 4.0-6.0 PCP/TPH OVA: 0ppm on spoon 0ppm in hole SS Run 4: 6.0-8.0 1.83/2.0 recovery OVA: 0ppm on spoon 0ppm in hole

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DRILLING LOG of BORING No. WP-4

State	Virginia	Start Date	7/26/89
Location	Chuckatuck	Completion Date	7/26/89
Drilling Firm	GES Inc.	Ground Elevation	40.20
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
40.20		Ground Surface				
40		0.0-1.0: TOPSOIL: black, topsoil, sand and gravel		1	1 2	HSA with split spoons for sampling
	1	1.0-4.0: SAND (SP): black, medium to fine grained			4 5	SS Run 1: 0.0-2.0 1.83/2.0 recovery
	2			2	1	Sample from 0.0-2.0 PCP/TPH
	3				1 2	OVA: 0ppm on spoon 0ppm in hole
	4				3	
		4.0-6.0: SAND (SW): grayish white, coarse grained		3	2 2	SS Run 2: 2.0-4.0 1.83/2.0 recovery
35	5	5.0-6.0: same as above but wet			3	Sample from 2.0-4.0 PCP/TPH
	6				5	OVA: 0ppm on spoon 0ppm in hole
						SS Run 3: 4.0-6.0 1.83/2.0 recovery
						Sample from 4.0-6.0 PCP/TPH
						OVA: 0ppm on spoon 0ppm in hole

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DRILLING LOG of BORING No. WP-5

State	Virginia	Start Date	5/21/90
Location	Chuckatuck	Completion Date	5/21/90
Drilling Firm	GES Inc.	Ground Elevation	42.25
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
42.25		Ground Surface				
		0.0-0.5: TOPSOIL: fine to very fine sand with roots and vegetation (fill)		1	3	HSA with split spoons for sampling
	1				4	
					4	SS Run 1: 0.0-2.0
	2	0.5-3.0: SAND (SP/SM): dark brown, fine to very fine grained (fill)			5	1.58/2.0 recovery
40				2	1	Sample from 0.0-2.0 PCP/TPH
	3				1	
		3.0-3.7: SAND (SP): grayish black, wet, fine grained sand with black fill			2	OVA: off scale on spoon off scale in hole
	4				2	
		3.7-5.4: SAND (SW): brownish, fine grained with trace of black fill		3	1	SS Run 2: 2.0-4.0
	5				2	1.67/2.0 recovery
					5	Sample from 2.0-4.0 PCP/TPH
	6	5.4-6.0: GRAVEL (GM): black fill and gravel with some sand, oily			13	OVA: 4ppm on spoon off scale in hole
						SS Run 3: 4.0-6.0 1.0/2.0 recovery
						Sample from 4.0-6.0 PCP/TPH
						OVA: 20ppm on spoon off scale in hole

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DRILLING LOG of BORING No. WP-6

State	Virginia	Start Date	5/21/90
Location	Chuckatuck	Completion Date	5/21/90
Drilling Firm	GES Inc.	Ground Elevation	42.60
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
42.60		Ground Surface				
	1	0.0-0.25: TOPSOIL: dark gray, fine grained with roots throughout and black fill		1		HSA with split spoons for sampling SS Run 1: 0.0-2.0 2.0/2.0 recovery Sample from 0.0-2.0 PCP/TPH OVA: 0ppm on spoon 20-30ppm in hole SS Run 2: 2.0-4.0 2.0/2.0 recovery Sample from 2.0-4.0 PCP/TPH OVA: 0ppm on spoon 0ppm in hole SS Run 3: 4.0-6.0 1.5/2.0 recovery Sample from 4.0-6.0 PCP/TPH OVA: 0ppm on spoon 0ppm in hole
	2	0.25-1.92: SAND (SP/SC): brown-orange, medium to fine grained, trace of thin clayey layers				
40	3			2		
	4	1.92-3.0: SAND (SP): black, medium to fine grained 3.0-6.0: SAND (SP): grayish brown, medium to fine grained, trace of roots, becomes clear to white at bottom		3		
	5	5.0-6.0: same as above but wet				
	6					

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DRILLING LOG of BORING No. WP-7

State	Virginia	Start Date	5/21/90
Location	Chuckatuck	Completion Date	5/21/90
Drilling Firm	GES Inc.	Ground Elevation	42.34
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count	Remarks
42.34		Ground Surface					
	1	0.0-0.33: SAND (SM): sand with 20% topsoil, vegetation and rootlets throughout		1		5	HSA with split spoons for sampling
						2	
						3	SS Run 1: 0.0-2.0
	2	0.33-6.0: SAND (SM/SC): brown to translucent white, medium to fine grained with some clayey sand, presence of black organics may indicate fill material				3	1.67/2.0 recovery
40				2		1	Sample from 0.0-2.0
	3					1	PCP/TPH
						1	OVA: 0ppm on spoon
	4	3.5-4: same as above but wet				2	>200ppm in hole
				3		1	SS Run 2: 2.0-4.0
	5					1	1.67/2.0 recovery
		5.0: CLAYEY SAND LAYER				1	Sample from 2.0-4.0
	6					1	PCP/TPH
							OVA: 50ppm on spoon 100ppm in hole
							SS Run 3: 4.0-6.0
							1.67/2.0 recovery
							Sample from 4.0-6.0
							PCP/TPH
							OVA: 0ppm on spoon 0ppm in hole

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DRILLING LOG of BORING No. WS-1

State	Virginia	Start Date	7/25/89
Location	Chuckatuck	Completion Date	7/25/89
Drilling Firm	GES Inc.	Ground Elevation	41.30
Type of Drill	CME 55	Total Depth of Boring	4.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
41.30		Ground Surface				
		0.0-1.0: GRAVEL (GW): road gravel		1	9	HSA with split spoons for sampling
	1				10	
40		1.0-2.3: SAND (SP): black and brownish black, medium to fine grained			15	SS Run 1: 0.0-2.0 1.83/2.0 recovery
	2				16	
				2	5	Sample from 0.0-2.0 PCP/TPH
	3	2.3-4.0: SAND (SW): white, locally tan, medium grained			6	OVA: 0ppm on spoon 0ppm in hole
					6	
	4				4	SS Run 2: 2.0-4.0 1.83/2.0 recovery
						Sample from 2.0-4.0 PCP/TPH
						OVA: 0ppm on spoon 0ppm in hole

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DRILLING LOG of BORING No. WS-2

State	Virginia	Start Date	7/24/89
Location	Chuckatuck	Completion Date	7/24/89
Drilling Firm	GES Inc.	Ground Elevation	45.80
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
45.80		Ground Surface				
		0.0-0.5: GRAVEL (GM): gravel and sandy topsoil (30%)		1	2	HSA with split spoons for sampling
45	1	0.5-3.0: SAND (SP): tan, medium to fine grained			3	
					3	SS Run 1: 0.0-2.0
	2				4	1.83/2.0 recovery
				2	2	Sample from 0.0-2.0
	3				2	PCP/TPH
		3.0-6.0: SAND (SP): gray and tan, medium to fine grained			3	OVA: 0ppm on spoon
	4				5	0ppm in hole
				3	4	SS Run 2: 2.0-4.0
	5				6	1.83/2.0 recovery
					5	Sample from 2.0-4.0
40	6				2	PCP/TPH
						OVA: 0ppm on spoon
						0ppm in hole
						SS Run 3: 4.0-6.0
						1.83/2.0 recovery
						Sample from 4.0-6.0
						PCP/TPH
						OVA: 0ppm on spoon
						0ppm in hole

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DRILLING LOG of BORING No. WS-3

State	Virginia	Start Date	7/25/89
Location	Chuckatuck	Completion Date	7/25/89
Drilling Firm	GES Inc.	Ground Elevation	41.50
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
41.50		Ground Surface				
		0.0-0.5: TOPSOIL: sandy topsoil with rootlets throughout		1	5	HSA with split spoons for sampling
	1				5	
40					5	SS Run 1: 0.0-2.0
	2	0.5-2.3: SAND (SP): black, medium to fine grained, slightly moist			4	1.83/2.0 recovery
				2	2	Sample from 0.0-2.0
	3				4	PCP/TPH
		2.3-6.0: SAND (SW): white, medium grained, wet			3	OVA: 0ppm on spoon
	4				2	0ppm in hole
				3	2	SS Run 2: 2.0-4.0
	5				1	1.83/2.0 recovery
					2	Sample from 2.0-4.0
	6				1	PCP/TPH
						OVA: 0ppm on spoon
						0ppm in hole
						SS Run 3: 4.0-6.0
						1.83/2.0 recovery
						Sample from 4.0-6.0
						PCP/TPH
						OVA: 0ppm on spoon
						0ppm in hole

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DRILLING LOG of BORING No. WS-4

State	Virginia	Start Date	7/24/89
Location	Chuckatuck	Completion Date	7/24/89
Drilling Firm	GES Inc.	Ground Elevation	44.90
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
44.90		Ground Surface				
		0.0-0.5: GRAVEL (GW): road gravel		1	7	HSA with split spoons for sampling
	1	0.5-5.0: SAND (SP): tan, medium to fine grained			3	
					8	SS Run 1: 0.0-2.0
	2				11	1.83/2.0 recovery
				2	3	Sample from 0.0-2.0
	3				6	PCP/TPH
					5	OVA: Oppm on spoon
	4				4	Oppm in hole
				3	4	SS Run 2: 2.0-4.0
40	5				7	1.83/2.0 recovery
		5.0-5.0: same as above but wet			11	Sample from 2.0-4.0
	5				18	PCP/TPH
						OVA: Oppm on spoon
						Oppm in hole
						SS Run 3: 4.0-6.0
						1.83/2.0 recovery
						Sample from 4.0-6.0
						PCP/TPH
						OVA: Oppm on spoon
						Oppm in hole

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DRILLING LOG of BORING No. WS-5

State: Virginia
Start Date: 7/14/89
Location: Chuckatuck
Completion Date: 7/14/89
Drilling Firm: GES Inc.
Ground Elevation: 40.78
Type of Drill: CME 55
Total Depth of Boring: 10.0'
Driller: D Pugh
Geologist: A. Ayuboha

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
40.78		Ground Surface				
40	1	0.0-1.0: FILL: black to gray sand with gravel, trace of bricks and cobbles		1	5 4	HSA with split spoons for sampling
	2	1.0-7.5: SAND (SP): white and orange, medium to fined grained, moist			4 5	SS Run 1: 0.0-2.0 1.5/2.0 recovery
	3			2	7 4	Sample from 0.0-2.0 PCP/TPH
	4				4 3	OVA: 0ppm on spoon 0ppm in hole
	5			3	7 7 5	SS Run 2: 2.0-4.0 1.83/2.0 recovery Sample from 2.0-4.0
35	6				6	PCP/TPH
	7			4	2 4 1	OVA: 0ppm on spoon 0ppm in hole SS Run 3: 4.0-6.0
	8	7.5-10.0: CLAY/SILTY CLAY (CL): black, 20% silt			1	1.83/2.0 recovery
	9			5	11 2	Sample from 4.0-6.0 PCP/TPH
	10				1 1	OVA: 0ppm on spoon 0ppm in hole
						SS Run 4: 6.0-8.0 1.83/2.0 recovery OVA: 0ppm on spoon 0ppm in hole SS Run 5: 8.0-10.0 1.83/2.0 recovery OVA: 0ppm on spoon 0ppm in hole

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DRILLING LOG of BORING No. WT-1

State	Virginia	Start Date	7/24/89
Location	Chuckatuck	Completion Date	7/24/89
Drilling Firm	GES Inc.	Ground Elevation	44.42
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
44.42		Ground Surface				
	1	0.0-2.0: GRAVEL (GW): road gravel and some sand at the bottom (10%)		1	0 30 32 40	HSA with split spoons for sampling SS Run 1: 0.0-2.0 1.83/2.0 recovery
	2					
	3	2.0-6.0: SAND (SP): fine to medium grained		2	3 4 7 5	Sample from 0.0-2.0 PCP/TPH OVA: 0ppm on spoon 0ppm in hole
40	4					
	5			3	3 5 7 4	SS Run 2: 2.0-4.0 1.83/2.0 recovery Sample from 2.0-4.0 PCP/TPH OVA: 0ppm on spoon 0ppm in hole
	6					SS Run 3: 4.0-6.0 1.83/2.0 recovery Sample from 4.0-6.0 PCP/TPH OVA: 0ppm on spoon 0ppm in hole

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DRILLING LOG of BORING No. WT-2

State	Virginia	Start Date	7/20/89
Location	Chuckatuck	Completion Date	7/20/89
Drilling Firm	GES Inc.	Ground Elevation	43.08
Type of Drill	CME 55	Total Depth of Boring	14.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
43.08		Ground Surface				
		0.0-1.0: GRAVEL (GW): road gravel		1	15	HSA with split spoons
	1				15	for sampling
		1.0-5.0: SAND (SP/SC): tan, fine grained sand with			17	SS Run 1: 0.0-2.0
	2	trace of gravel at top, locally thin layers of			16	1.83/2.0 recovery
		clayey sand (10%)		2	4	Sample from 0.0-2.0
40	3				7	PCP/TPH
					8	OVA: Oppm on spoon
	4				9	Oppm in hole
				3	2	SS Run 2: 2.0-4.0
	5				2	1.83/2.0 recovery
		5.0-8.5: SAND (SP/SC): gray to white, medium grained			2	Sample from 2.0-4.0
	6	sand alternating with clayey sand (20%), wet			4	PCP/TPH
				4	2	OVA: Oppm on spoon
	7				3	Oppm in hole
					3	SS Run 3: 4.0-6.0
35	8				4	1.67/2.0 recovery
				5	2	Sample from 4.0-6.0
	9	8.5-9.5: CLAYEY SAND (SC): gray, 40% clay			4	PCP/TPH
					4	OVA: Oppm on spoon
	10	9.5-13.0: SAND (SW/SP): gray, coarse grained quartz			7	Oppm in hole
		sand, finer at bottom		6	5	SS Run 4: 6.0-8.0
	11				8	1.67/2.0 recovery
					5	OVA: Oppm on spoon
	12				5	Oppm in hole
				7	3	SS Run 5: 8.0-10.0
30	13				3	1.83/2.0 recovery
		13.0-14.0: CLAY/SANDY CLAY (CL): black, 40% sand			4	OVA: Oppm on spoon
	14				5	Oppm in hole
						SS Run 6: 10.0-12.0
						1.83/2.0 recovery
						OVA: Oppm on spoon
						Oppm in hole

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DRILLING LOG of BORING No. WT-2

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
						SS Run 7: 12.0-14.0 1.83/2.0 recovery OVA: 0ppm on spoon 0ppm in hole

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DRILLING LOG of BORING No. WT-3

State	Virginia	Start Date	5/22/90
Location	Chuckatuck	Completion Date	5/22/90
Drilling Firm	GES Inc.	Ground Elevation	44.03
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D. Pugh		
Geologist	A. Ayubcha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
44.03		Ground Surface				
	1	0.0-1.0: SAND (SP): black, fine to medium grained, possibly fill		1		HSA with split spoons for sampling SS Run 1: 0.0-2.0 1.75/2.0 recovery Sample from 0.0-2.0 PCP/TPH OVA: 0ppm on spoon 1ppm in hole SS Run 2: 2.0-4.0 1.83/2.0 recovery Sample from 2.0-4.0 PCP/TPH OVA: 2ppm on spoon 3-5ppm in hole SS Run 3: 4.0-6.0 1.8/2.0 recovery Sample from 4.0-6.0 PCP/TPH OVA: 0ppm on spoon 5-15ppm in hole NOTE: water level may be elevated due to heavy rains on 5/21 to 5/22/90
	2	1.0-5.33: SAND (SP): gray to transparent, fine to medium grained		2		
	3	3.0: same as above but wet				
40	4			3		
	5					
	6	5.33-6.0: SAND (SP): brown, fine to medium grained				

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DRILLING LOG of BORING No. WT-4

State	Virginia	Start Date	5/23/90
Location	Chuckatuck	Completion Date	5/23/90
Drilling Firm	GES Inc.	Ground Elevation	42.85
Type of Drill	CME 55	Total Depth of Boring	6.0'
Driller	D Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
42.85		Ground Surface				
		0.0-0.5: SAND (SM): sand and black topsoil		1		HSA with split spoons for sampling
	1	0.5-3.17: SAND (SP/SC): brown, fine to medium grained, with clayey sand at the bottom (10% clay)				SS Run 1: 0.0-2.0 2.0/2.0 recovery
	2			2		Sample from 0.0-2.0 PCP/TPH
40	3					OVA: 0ppm on spoon 3ppm in hole
	4	3.17-6.0: SAND (SW): gray to clear, fine grained, locally brownish		3	2	SS Run 2: 2.0-4.0 1.67/2.0 recovery
	5	4.0-6.0: same but coarser grained			4	Sample from 2.0-4.0 PCP/TPH
					1	OVA: 0ppm on spoon 5ppm in hole
	6				5	SS Run 3: 4.0-6.0 1.75/2.0 recovery
						Sample from 4.0-6.0 PCP/TPH
						OVA: 0ppm on spoon 2ppm in hole

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DRILLING LOG of BORING No. WT-5

State	Virginia	Start Date	5/22/90
Location	Chuckatuck	Completion Date	5/22/90
Drilling Firm	GES Inc.	Ground Elevation	41.17
Type of Drill	CME 55	Total Depth of Boring	14.0'
Driller	D. Pugh		
Geologist	A. Ayuboha		

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
41.17		Ground Surface				
		0.0-0.8: GRAVEL (GW): road gravel and topsoil		1	1	HSA with split spoons
40	1				3	for sampling
		0.8-5.7: SAND (SP): brown, fine to medium and fine			2	SS Run 1: 0.0-2.0
	2	grained, locally rusty colored			2	1.75/2.0 recovery
				2	5	Sample from 0.0-2.0
	3				12	PCP/TPH
					12	OVA: 0ppm on spoon
	4				10	3ppm in hole
				3	4	SS Run 2: 2.0-4.0
	5				5	2.0/2.0 recovery
					2	Sample from 2.0-4.0
35	6				3	PCP/TPH
		5.7-7.8: CLAY (CL): gray, stiff		4	3	OVA: 0.5-1ppm on spoon
	7				5	1ppm in hole
					10	SS Run 3: 4.0-6.0
	8				5	1.67/2.0 recovery
		7.8-8.4: SANDY CLAY (CL): gray, transitional facies		5	4	Sample from 4.0-6.0
	9				10	PCP/TPH
		8.4-9.8: SAND (SP): gray, coarse grained, with			10	OVA: 0ppm on spoon
	10	some cobbles			6	2ppm in hole
				6		SS Run 4: 6.0-8.0
30	11	9.8-10.0: CLAY (CL): greenish brown				1.75/2.0 recovery
		10.0-10.75: CLAY and SAND (CL/SC): interfingering				OVA: 0ppm on spoon
	12	gray clay and clayey sand				1ppm in hole
				7		SS Run 5: 8.0-10.0
	13	10.75-11.75: CLAY (CL): greenish gray, sticky				1.67/2.0 recovery
						OVA: 0ppm on spoon
	14	11.75-14.0: CLAY and SAND (CL/SC): interfingerings				0.5-1ppm in hole
		of gray clay, sand and sandy clay				SS Run 6: 10.0-12.0
						2.0/2.0 recovery
						OVA: 0ppm on spoon
						0ppm in hole

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DRILLING LOG of BORING No. WT-5

State: Virginia Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks
						SS Run 7: 12.0-14.0 2.0/2.0 recovery OVA: 0ppm on spoon 0ppm in hole

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MONITORING WELLS

DRILLING LOG of WELL No. MW-1-S

State	Virginia	Start Date	7/22/89
Location	Chuckatuck	Completion Date	7/22/89
Drilling Firm	GES Inc.	Ground Elevation	45.41
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	3.02 ▼
		after 60 days	3.90 ▼
Geologist	A. Ayuboha	Total Depth of Boring	8.5'
			Lock #

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Counts	Remarks	Well Const.
45.41		Ground Surface				Stickup = 1.77	
45	1	0.0-7.5: SAND (SW): gray, clear, fine grained, darker at bottom				HSA with split spoons for sampling Auger Run 1: 0.0-6.0 OVA: Oppm in hole	
	2						
	3						
	4						
40	5						
	6			1	2	SS Run 1: 6.0-8.0	
	7				1	1.83/2.0 recovery	
					7	OVA: Oppm on spoon	
	8	7.5-8.5: CLAY/CLAYEY SILT (CL-ML): dark gray, 50% silt			8	Oppm in hole	

*For rock coring = % Recovery (RQD)

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DRILLING LOG of WELL No. MW-2-D

State	Virginia	Start Date	7/11/89
Location	Chuckatuck	Completion Date	7/13/89
Drilling Firm	GES Inc.	Ground Elevation	45.23
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	8.18 ▼
		after 60 days	10.60 ▼
Geologist	A. Ayuboha	Total Depth of Boring	40.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Counts	Remarks	Well Const.
45.23		Ground Surface					Stickup = 1.86	
45		0.0-0.5: SAND (SW): gray, translucent, fine grained, 2" topsoil		1		2	NOTE: This point	
	1					3	overlays B-1	
						2	HSA with split spoons	
	2	0.5-1.0: SAND (SW): dark gray and locally black, fine grained				2	for sampling	
				2		1	SS Run 1: 0.0-2.0	
	3	1.0-2.1: SAND (SW): brownish white, fine grained				2	1.83/2.0 recovery	
						2	OVA: Oppm on spoon	
	4	2.1-6.5: SAND (SW): brown, fine grained, wet at bottom				3	Oppm in hole	
				3		2	SS Run 2: 2.0-4.0	
	5					4	1.83/2.0 recovery	
40						4	OVA: Oppm on spoon	
	6					3	Oppm in hole	
				4		1	SS Run 3: 4.0-6.0	
	7	6.5-8.7: CLAYEY SAND (SC): brown, locally silty (@10%), @20% clay				2	1.83/2.0 recovery	
						4	OVA: Oppm on spoon	
	8					4	Oppm in hole	
				5		1	SS Run 4: 6.0-8.0	
	9					1	1.67/2.0 recovery	
		8.7-16.3: CLAY/CLAYEY SILT (CL-ML): dark gray, @20% clayey silt				1	OVA: Oppm on spoon	
						4	Oppm in hole	

*For rock coring = % Recovery (RQD)

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DRILLING LOG of WELL NO. MW-2-D

State: Virginia Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks	Well Const.
35				6	2	SS Run 5: 8.0-10.0	
	11				2	1.83/2.0 recovery	
					1	OVA: Oppm on spoon	
	12				3	Oppm in hole	
				7	4	SS Run 6: 10.0-12.0	
	13				6	1.83/2.0 recovery	
					11	OVA: Oppm on spoon	
	14				13	Oppm in hole	
				8	3	SS Run 7: 12.0-14.0	
	15				3	1.83/2.0 recovery	
30					3	OVA: Oppm on spoon	
	16				5	Oppm in hole	
				9	4	SS Run 8: 14.0-16.0	
	17	16.3-18.3: SILTY SAND (SM): brown, @10% silt, locally clayey sand (10% clay)			5	1.83/2.0 recovery	
					9	OVA: Oppm on spoon	
	18				15	Oppm in hole	
				10	2	SS Run 9: 16.0-18.0	
	19	18.3-19.3: CLAY/CLAYEY SILT (CL-ML): black to dark gray, @20% clayey silt			2	1.83/2.0 recovery	
					4	OVA: Oppm on spoon	
	20				5	Oppm in hole	
25		19.3-32.0: SAND (SW): dark gray, fine grained, abundant white shell fragments (Yorktown Formation)				SS Run 10: 18.0-20.0	
	21					1.83/2.0 recovery	
						OVA: Oppm on spoon	
	22					Oppm in hole	
						Augered: 20.0-40.0	
	23					OVA: Oppm in hole	
	24						
	25						
20							
	26						
	27						
	28						
	29						
15							
	30						
	31						
	32						
	33	32.0-40.0: SILTY SAND (SM): gray to dark gray, @20% silt, trace white shells					

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DRILLING LOG of WELL NO. MW-2-D

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count	Remarks	Well Const.
	34							
10-	35							
	36							
	37							
	38							
	39							
	40							

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DRILLING LOG of WELL No. MW-3-S

State	Virginia	Start Date	7/21/89
Location	Chuckatuck	Completion Date	7/22/89
Drilling Firm	GES Inc.	Ground Elevation	45.26
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	5.86 ▼
		after 60 days	4.30 ▼
Geologist	A. Ayubgha	Total Depth of Boring	16.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Counts	Remarks	Well Const.
45.26		Ground Surface					Stickup = -0.19	
45		0.0-0.5: GRAVEL (GW): road gravel		1		9	NOTE: This point	
	1	0.5-1.0: SAND (SW): dark gray, medium grained				10	overlays ST-1	
		1.0-2.5: SAND (SP): yellow to tan, medium to				12	HSA with split spoons	
	2	fined grained				7	for sampling	
				2		3	SS Run 1: 0.0-2.0	
	3	2.5-6.0: SAND (SP): light gray to white fine				5	1.83/2.0 recovery	
		grained sand with trace tan, medium grained				4	OVA: Oppm on spoon	
	4	sand				5	Oppm in hole	
				3		2	SS Run 2: 2.0-4.0	
	5					1	1.83/2.0 recovery	
40						2	OVA: Oppm on spoon	
	6					2	Oppm in hole	
		6.0-8.5: SAND (SW): white to tan, medium		4		5	SS Run 3: 4.0-6.0	
	7	grained, wet				5	1.0/2.0 recovery	
						5	OVA: Oppm on spoon	
	8					6	Oppm in hole	
				5		2	SS Run 4: 6.0-8.0	
	9	8.5-8.7: CLAYEY SAND (SC): black, organic-rich,				2	1.67/2.0 recovery	
		40% clay				3	OVA: Oppm on spoon	
		8.7-9.7: SAND (SP): black to dark gray, medium				4	Oppm in hole	

*For rock coring = % Recovery (RQD)

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DRILLING LOG of WELL NO. MW-3-S

State: Virginia Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count	Remarks	Well Const.
35		to fine grained		6		3	SS Run 5: 8.0-10.0	
	11	9.7-11.0: SAND (SW): white to gray, fine grained				6	1.83/2.0 recovery	
		11.0-13.0: SAND (SP): gray to dark gray				5	OVA: Oppm on spoon	
	12					2	Oppm in hole	
				7		2	SS Run 6: 10.0-12.0	
	13					2	1.83/2.0 recovery	
		13.0-14.0: CLAY/SANDY CLAY (CL): greenish gray				2	OVA: Oppm on spoon	
	14	clay and 20% sandy clay, trace oily sand				2	Oppm in hole	
				8			SS Run 7: 12.0-14.0	
							1.83/2.0 recovery	
							OVA: Oppm on spoon	
							Oppm in hole	
							Shelby Tube: 14.0-16.0	

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DRILLING LOG of WELL No. MW-4-S

State	Virginia	Start Date	7/20/89
Location	Chuckatuck	Completion Date	7/20/89
Drilling Firm	GES Inc.	Ground Elevation	43.08
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	7.00 ▼
Geologist	A. Ayuboha	after 60 days	7.50 ▼
		Total Depth of Boring	14.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count*	Remarks	Well Const.
43.08		Ground Surface				Stickup = -0.38	
		0.0-1.0: GRAVEL (GW): road gravel		1	15	NOTE: This point	
	1				15	overlays MT-2	
		1.0-5.0: SAND (SP/SC): tan, fine grained sand			17	HSA with split spoons	
	2	with trace of gravel at top, locally thin			16	for sampling	
		layers of clayey sand (10%)		2	4	SS Run 1: 0.0-2.0	
40	3				7	1.83/2.0 recovery	
					8	OVA: Oppm on spoon	
	4				9	Oppm in hole	
				3	2	HSA with split spoons	
	5				2	SS Run 2: 2.0-4.0	
		5.0-8.5: SAND (SP/SC): gray to white, medium			2	1.83/2.0 recovery	
	6	grained sand alternating with clayey sand			4	OVA: Oppm on spoon	
		(20%), wet		4	2	Oppm in hole	
	7				3	SS Run 3: 4.0-6.0	
					3	1.83/2.0 recovery	
35	8				4	OVA: Oppm on spoon	
				5	2	Oppm in hole	
	9	8.5-9.5: CLAYEY SAND (SC): gray, 40% clay			4	SS Run 4: 6.0-8.0	
					4	1.83/2.0 recovery	
		9.5-13.0: SAND (SW/SP): gray, coarse grained			7	OVA: Oppm on spoon	

*For rock coring = % Recovery (RQD)

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DRILLING LOG of WELL NO. MW-4-S

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks	Well Const.
		quartz sand, finer at bottom		6	5	0ppm in hole	
	11				8	SS Run 5: 8.0-10.0	
					6	1.83/2.0 recovery	
	12				5	OVA: 0ppm on spoon	
				7	3	0ppm in hole	
30	13				3	SS Run 6: 10.0-12.0	
		13.0-14.0: CLAY/SANDY CLAY (CL): black, 40% sand			4	1.83/2.0 recovery	
	14				5	OVA: 0ppm on spoon	
						0ppm in hole	
						SS Run 7: 12.0-14.0	
						1.83/2.0 recovery	
						OVA: 0ppm on spoon	
						0ppm in hole	

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DRILLING LOG of WELL No. MW-5-S

State	Virginia	Start Date	7/14/89
Location	Chuckatuck	Completion Date	7/14/89
Drilling Firm	GES Inc.	Ground Elevation	40.78
Type of Drill	CME 55	Groundwater Depth:	
Driller	D. Pugh	at completion	3.71 ▼
Geologist	A. Ayubaha	after 60 days	4.00 ▼
		Total Depth of Boring	10.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count*	Remarks	Well Const.
40.78		Ground Surface				Stickup = -0.38	
40	1	0.0-1.0: FILL: black to gray sand with gravel, trace of bricks and cobbles		1	5 4	NOTE: This point overlays WS-5	
	2	1.0-7.5: SAND (SP): white and orange, medium to fined grained, moist			4 5	HSA with split spoons for sampling	
	3			2	7 4	SS Run 1: 0.0-2.0 1.5/2.0 recovery	
	4				4 3	OVA: Oppm on spoon Oppm in hole	
	5			3	7 7	SS Run 2: 2.0-4.0 1.83/2.0 recovery	
35	6				5 6	OVA: Oppm on spoon Oppm in hole	
	7			4	2 4	SS Run 3: 4.0-6.0 1.83/2.0 recovery	
	8	7.5-10.0: CLAY/SILTY CLAY (CL): black, 20% silt			1 1	OVA: Oppm on spoon Oppm in hole	
	9			5	11 2	SS Run 4: 6.0-8.0 1.83/2.0 recovery	
					1 1	OVA: Oppm on spoon Oppm in hole	

*For rock coring = % Recovery (RQD)

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DRILLING LOG OF WELL NO. MW-5-S

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count	Remarks	Well Const.
							SS Run 5: 8.0-10.0 1.83/2.0 recovery OVA: Oppm on spoon Oppm in hole	

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DRILLING LOG of WELL No. MW-6-D

State	Virginia	Start Date	9/19/89
Location	Chuckatuck	Completion Date	9/27/89
Drilling Firm	GES Inc.	Ground Elevation	40.90
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	9.00 ▼
Geologist	A. Ayuboha	after 270 days	8.30 ▼
		Total Depth of Boring	40.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Counts	Remarks	Well Const.
40.90		Ground Surface					Stickup = -0.62	
40	1	0.0-7.7: SAND (SP): brown to tan, medium to fined grained					HSA with split spoons for sampling	
	2							
	3							
	4							
	5							
35	6							
	7			1		pushed	SS Run 1: 7.0-9.0 1.83/2.0 recovery	
	8	7.7-8.2: SILTY SAND (SM): dark gray, fine grained, @20% silty sand, locally clayey					OVA: Oppm on spoon Oppm in hole	
	9	8.2-10.0: SAND (SW): dark gray and black, medium		2		pushed	SS Run 2: 9.0-11.0 1.83/2.0 recovery	

*For rock coring = % Recovery (RQD)

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DRILLING LOG of WELL NO. MW-6-D

State: Virginia Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks	Well Const.
		grained				OVA: Oppm on spoon	
30	11	10.0-11.7: CLAY (CL): greenish black clay, sand at bottom (@20%)				Oppm in hole Moved 2ft: Augered	
	12					from 0.0-10.0 to obtain Shelby Tube Sample	
	13	11.7-19.0: CLAY and SAND (CL/SP): greenish gray clay (@50%) interfingered with black and gray, medium grained sand (@50%)		4	1	from 10.0-12.0	
	14				1	SS Run 3: 11.0-13.0	
					2	1.83/2.0 recovery	
	15				3	OVA: Oppm on spoon	
				5	2	Oppm in hole	
25	16				1	Clay sample: 11.0-13.	
					4	SS Run 4: 13.0-15.0	
	17				5	1.83/2.0 recovery	
				6	2	OVA: Oppm on spoon	
	18				2	Oppm in hole	
					3	SS Run 5: 15.0-17.0	
	19				4	1.83/2.0 recovery	
		19.0-40.0: SILTY SAND and SILT (SM/ML): gray silty sand and silt, abundant white and gray shell fragments (large size shells>1/2")		7	1	OVA: Oppm on spoon	
	20				2	Oppm in hole	
					7	SS Run 6: 17.0-19.0	
20	21				1	1.83/2.0 recovery	
						OVA: Oppm on spoon	
	22					Oppm in hole	
						SS Run 7: 19.0-21.0	
	23					1.83/2.0 recovery	
						OVA: Oppm on spoon	
	24					Oppm in hole	
				8	3	SS Run 8: 24.0-26.0	
	25				3	1.83/2.0 recovery	
					5	OVA: Oppm on spoon	
15	26				7	Oppm in hole	
						Augered: 26.0-34.0	
	27					OVA: Oppm in hole	
	28						
	29						
	30						
10	31						
	32						
	33						

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DRILL LOG of WELL NO. MW-6-D

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count	Remarks	Well Const.
	34							
	35			9		1	SS Run 9: 34.0-36.0	
						2	1.83/2.0 recovery	
						2	OVA: Oppm on spoon	
5	36					4	Oppm in hole	
	37							
	38			10		2	SS Run 10: 38.0-40.0	
	39					2	1.83/2.0 recovery	
						3	OVA: Oppm on spoon	
	40					4	Oppm in hole	
							NOTE: Installed 8"ID low carbon steel casing to 11 ft.	

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL No. MW-7-S

State	Virginia	Start Date	9/22/89
Location	Chuckatuck	Completion Date	9/22/89
Drilling Firm	GES Inc.	Ground Elevation	41.22
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	4.01 ▼
		after 270 days	3.20 ▼
Geologist	A. Ayuboha	Total Depth of Boring	14.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count*	Remarks	Well Const.
41.22		Ground Surface					Stickup = -.59	
		0.0-6.0: SAND (SW): tan, medium grained		1		2	HSA with split spoons	
40	1					4	for sampling	
						3	SS Run 1: 0.0-2.0	
	2					3	1.83/2.0 recovery	
				2		3	OVA: Oppm on spoon	
	3					1	2ppm in hole	
						1	SS Run 2: 2.0-4.0	
	4					4	1.83/2.0 recovery	
		4.0-5.0: same as above but WET		3		2	OVA: Oppm on spoon	
	5					3	Oppm in hole	
						4	SS Run 3: 4.0-6.0	
	6					5	1.83/2.0 recovery	
35		6.0-8.2: SAND (SW): white, medium grained, wet		4		3	OVA: Oppm on spoon	
	7					3	Oppm in hole	
						4	SS Run 4: 6.0-8.0	
	8					15	1.83/2.0 recovery	
				5		4	OVA: Oppm on spoon	
	9	8.2-11.0: SAND (SP/SC): gray, medium to coarse grained with thin (1-2") layers of clayey sand				4	0.6ppm in hole	
						7	SS Run 5: 8.0-10.0	
						8	1.83/2.0 recovery	

*For rock coring = % Recovery (RQD)

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL NO. MW-7-S

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks	Well Const.
				6	4 9	OVA: Oppm on spoon 0.5ppm in hole	
30	11	11.0-12.0: SAND (SP): white, medium to coarse grained			9 5	SS Run 6: 10.0-12.0 1.83/2.0 recovery	
	12	12.0-14.0: CLAY (CL): greenish gray, trace sand locally		7	1 1 1 1	OVA: Oppm on spoon 0.5ppm in hole SS Run 7: 12.0-14.0 1.83/2.0 recovery OVA: Oppm on spoon 0.5ppm in hole	
	13						
	14						

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL No. MW-8-D

State: Virginia
Location: Chuckatuck
Drilling Firm: GES Inc.
Type of Drill: CME 55
Driller: D. Pugh
Geologist: A. Ayuboha

Start Date: 9/22/89
Completion Date: 9/29/89
Ground Elevation: 41.37
Groundwater Depth
at completion: 11.86 ▼
after 270 days: 10.70 ▼
Total Depth of Boring: 26.0'
Lock #

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Counts	Remarks	Well Const.
41.37		Ground Surface					Stickup = -0.43	
40	1	0.0-6.0: SAND (SW): tan, medium grained					HSA with split spoons for sampling Auger: 0.0-12.0 OVA: 0.5-1ppm in hole	
	2							
	3							
	4							
	5	4.0-5.0: same as above but WET						
	6							
35	7	6.0-8.2: SAND (SW); white, medium grained, wet						
	8							
	9	8.2-11.0: SAND (SP/SC): gray, medium to coarse grained with thin (1-2") layers of clayey sand						

*For rock coring = % Recovery (RQD)

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL NO. MW-8-D Page 2 of 2

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks	Well Const.
	11						
30	12	11.0-12.0: SAND (SP): white, medium to coarse grained					
	13	12.0-14.0: CLAY (CL): greenish gray, trace silty clay, trace thin (1") layers of clayey sand		1		Shelby Tube: 12.0-14.	
	14						
	15	14.0-17.3: SAND (SP): greenish gray, medium to coarse grained with 1" yellow clay layers (<10%)		2	1	SS Run 1: 14.0-16.0	
					2	1.83/2.0 recovery	
					3	OVA: Oppm on spoon	
	16				4	2ppm in hole	
25				3	1	SS Run 2: 16.0-18.0	
	17				2	1.83/2.0 recovery	
					1	OVA: Oppm on spoon	
	18	17.3-18.0: SILTY CLAY and SILT (CL/ML): greenish gray, 840% silt, 860% silty clay			3	2ppm in hole	
	19					Augered from 18.0-24.0	
		18.0-26.0: SILTY SAND (SM): gray, abundant white and gray shells (Yorktown Formation)					
	20						
20	21						
	22						
	23						
	24						
				4	2	SS Run 3: 24.0-26.0	
	25				4	1.83/2.0 recovery	
					7	OVA: Oppm on spoon	
	26				1	0.5ppm in hole	
						NOTE: Installed 8"ID low carbon steel casing to 13 ft	

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL No. MW-9-S

State	Virginia	Start Date	7/25/89
Location	Chuckatuck	Completion Date	7/25/89
Drilling Firm	GES Inc.	Ground Elevation	37.87
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	10.50 ▼
		after 60 days	10.50 ▼
Geologist	A. Ayuboha	Total Depth of Boring	14.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count*	Remarks	Well Const.
37.87		Ground Surface					Stickup = -0.15	
		0.0-1.3: SAND (SM): black sand and topsoil		1		3	HSA with split spoons	
	1					5	for sampling	
						5	SS Run 1: 0.0-2.0	
	2	1.3-2.0: SAND (SP): white, medium to fine				4	1.83/2.0 recovery	
		grained, moist		2		3	OVA: Oppm on spoon	
35	3					5	Oppm in hole	
		2.0-5.75: SAND/CLAYEY SAND (SP/SC): brownish				5	SS Run 2: 2.0-4.0	
	4	gray, compact sand and 20% clayey sand				6	1.83/2.0 recovery	
				3		2	OVA: Oppm on spoon	
	5					4	Oppm in hole	
						4	SS Run 3: 4.0-6.0	
	6					6	1.83/2.0 recovery	
		5.75-9.5: SAND (SW): tan, coarse grained		4		2	OVA: Oppm on spoon	
	7					2	Oppm in hole	
						3	SS Run 4: 6.0-8.0	
30	8					6	1.83/2.0 recovery	
				5		3	OVA: Oppm on spoon	
	9					4	Oppm in hole	
						6	SS Run 5: 8.0-10.0	
		9.5-10.3: SAND (SM-SC): tan and gray, fine				9	1.83/2.0 recovery	

*For rock coring = % Recovery (RQD)

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL NO. MW-9-S

State: Virginia Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks	Well Const.
		grained locally silty (<20%) with trace of clay		6	3	OVA: Oppm on spoon	
	11				4	Oppm in hole	
		10.3-13.0 Sand (SW): white and brown, medium			7	SS Run 6: 10.0-12.0	
	12	grained, wet			5	1.83/2.0 recovery	
				7	2	OVA: Oppm on spoon	
25	13	13.0-13.5 same as above with rusty, iron-rich material			2	Oppm in hole	
					3	SS Run 7: 12.0-14.0	
	14	13.5-14.0 Clay (CL): greenish gray, stiff			4	1.83/2.0 recovery	
						OVA: Oppm on spoon	
						Oppm in hole	

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL No. MW-10-D

State	Virginia	Start Date	9/20/89
Location	Chuckatuck	Completion Date	9/26/89
Drilling Firm	GES Inc.	Ground Elevation	37.64
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	11.11 ▼
		after 270 days	12.70 ▼
Geologist	A. Ayuboha	Total Depth of Boring	26.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Counts	Remarks	Well Const.
37.64		Ground Surface				Stickup = -0.28	
	1	0.0-1.0: SAND (SM): black sand and topsoil		1	3 5	NOTE: This point overlays KF-2	
	2	1.0-2.0: SAND (SP): white, medium to fine grained, wet			5 4	HSA with split spoons for sampling	
35	3	2.0-6.0: SAND and CLAYEY SAND (SP/SC): brownish gray, compact sand and clayey sand (<20%)		2	3 5 5	SS Run 1: 0.0-2.0 1.83/2.0 recovery OVA: Oppm on spoon	
	4			3	6 2	Oppm in hole SS Run 2: 2.0-4.0	
	5				4 4	1.83/2.0 recovery OVA: Oppm on spoon	
	6				6	Oppm in hole	
	7	6.0-9.5: SAND (SW): tan, coarse grained		4	2 2	SS Run 3: 4.0-6.0 1.83/2.0 recovery	
30	8				3 6	OVA: Oppm on spoon Oppm in hole	
	9			5	3 4	SS Run 4: 6.0-8.0 1.83/2.0 recovery	
		9.5-10.0: SAND (SP): tan and gray, fine grained.			6 9	OVA: Oppm on spoon Oppm in hole	

*For rock coring = % Recovery (RQD)

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL NO. MW-10-D

State: Virginia Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count	Remarks	Well Const.
	11	locally silty (@10%) and clayey (@10%)		6			SS Run 5: 8.0-10.0 1.83/2.0 recovery OVA: Oppm on spoon Oppm in hole	
	12	10.0-13.0: SAND (SW): tan and orange, coarse grained, wet						
25	13			7			SS Run 6: 10.0-12.0 1.83/2.0 recovery OVA: Oppm on spoon Oppm in hole	
	14	13.0-14.0: CLAYEY SILT/SILTY CLAY (ML/CL): greenish gray, @ 50% clayey silt						
	15	14.0-20.3: SILTY SAND (SM): dark greenish gray, @20% silt, trace of clay, trace of white shell fragments at bottom		8		2 3	SS Run 7: 12.0-14.0 1.83/2.0 recovery OVA: Oppm on spoon Oppm in hole	
	16					5 6		
	17			9			SS Run 8: 14.0-16.0 1.83/2.0 recovery OVA: Oppm on spoon Oppm in hole Shelby Tube: 16.0-18.0 OVA: Oppm in hole Augered: 18.0-24.0 OVA: Oppm in hole	
20	18							
	19							
	20							
	21	20.3-26.0: SILT/SILTY SAND (ML/SM): gray, @40% silty sand, abundant white shell fragments (Yorktown Formation)						
	22							
15	23							
	24			10		2	SS Run 9: 24.0-26.0	
	25					2 3	1.83/2.0 recovery OVA: Oppm on spoon Oppm in hole	
	26					4		

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL No. MW-11-S

State	Virginia	Start Date	7/15/89
Location	Chuckatuck	Completion Date	7/15/89
Drilling Firm	GES Inc.	Ground Elevation	35.4'
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	8.05 ▼
Geologist	A. Ayuboha	after 60 days	8.50 ▼
		Total Depth of Boring	18.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count*	Remarks	Well Const.
35.40		Ground Surface				Stickup = 0.02	
35		0.0-1.0: SAND (SP): brown, locally black, medium to fine grained		1	3 2	NOTE: This point overlays KF-5	
	1						
		1.0-9.0: SAND (SP): brown and white, medium to fine grained			2 1	HSA with split spoons for sampling	
	2			2	4 3	SS Run 1: 0.0-2.0 1.83/2.0 recovery	
	3				3 4	OVA: Oppm on spoon Oppm in hole	
	4			3	2 3	SS Run 2: 2.0-4.0 1.83/2.0 recovery	
	5				4 3	OVA: Oppm on spoon Oppm in hole	
30	6			4	3 3	SS Run 3: 4.0-6.0 1.83/2.0 recovery	
	7				5 8	OVA: Oppm on spoon Oppm in hole	
	8			5	3 2	SS Run 4: 6.0-8.0 1.83/2.0 recovery	
	9	9.0-10.0: CLAYEY SILTY SAND (SM-SC): brownish gray, 20% clay, 20% silt			2 3	OVA: Oppm on spoon Oppm in hole	

*For rock coring = % Recovery (RQD)

Saunders Supply Company

Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL NO. MW-11-S

State: Virginia Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks	Well Const.
25	11	11.0-13.0: SAND (SW): brown, coarse grained, very coarse grained at bottom, trace of black organics		5	1 1 1 1	SS Run 5: 8.0-10.0 1.83/2.0 recovery OVA: Oppm on spoon Oppm in hole	
	12			7	2 2	SS Run 6: 10.0-12.0 1.83/2.0 recovery	
	13	13.0-13.5: SAND (SW): brown, rusty, iron-rich, coarse grained			2 3	OVA: Oppm on spoon Oppm in hole	
	14			8	3 2	SS Run 7: 12.0-14.0 1.83/2.0 recovery	
	15	13.5-17.5: CLAYEY SILT (ML): gray, 20% clay, 20% sandy clay			3 4	OVA: Oppm on spoon Oppm in hole	
20	16			9	4	SS Run 8: 14.0-16.0	
	17				4 4	1.83/2.0 recovery OVA: Oppm on spoon	
	18	17.5-18.0: SILTY SAND (SM): gray with white shell fragments			8	Oppm in hole SS Run 9: 16.0-18.0 1.83 recovery OVA: Oppm on spoon Oppm in hole	

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL No. MW-12-D

State	Virginia	Start Date	9/21/89
Location	Chuckatuck	Completion Date	9/27/89
Drilling Firm	GES Inc.	Ground Elevation	34.73
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	3.52 ▼
Geologist	A. Ayubona	after 270 days	8.80 ▼
		Total Depth of Boring	40.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Counts	Remarks	Well Const.
34.73		Ground Surface					Stickup = -0.25	
	1	0.0-2.0: SAND (SW): tan, medium grained					HSA with split spoons for sampling Auger: 0.0-10.0 OVA: Oppm in hole	
	2							
	3	2.0-4.0: SAND (SW): white, medium grained						
	4							
30	5	4.0-10.4: SAND (SW): tan and orange, medium grained						
	6							
	7							
	8							
	9							
25								

*For rock coring = % Recovery (RQD)

Saunders Supply Company

Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL NO. MW-12-D

State: Virginia Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks	Well Const.
				1		SS Run 1: 10.0-12.0	
	11	10.4-11.2: SILTY SAND (SM): tan and gray, @10% silt, locally thin gray clay layers				1.83/2.0 recovery	
						Pushed not hammered	
	12	11.2-12.6: CLAY (CL): gray, @20% clayey silt		2		OVA: Oppm on spoon	
						Oppm in hole	
	13	12.6-14.0: CLAY and SAND (CL/SP): gray, clay and sand, 7" clay at bottom of the auger				SS Run 2: 12.0-14.0	
						0.42/2.0 recovery	
	14					Pushed not hammered	
		14.0-14.5: SAND (SW): white, coarse grained		3	1	OVA: Oppm on spoon	
20	15	14.5-15.5: CLAYEY SILT (ML): greenish grey, @20% clay, @20% sand			3	Oppm in hole	
					5	SS Run 3: 14.0-16.0	
	16	15.5-40.0: SILT and SILTY SAND (ML/SM): gray, abundant gray shell fragments (Yorktown Formation)			5	1.83/2.0 recovery	
						OVA: Oppm on spoon	
	17					Oppm in hole	
						Augered: 16.0-19.0	
	18					OVA: Oppm in hole	
						1.83/2.0 recovery	
	19					OVA: Oppm on spoon	
				4	4	Oppm in hole	
15	20				4	SS Run 4: 19.0-21.0	
					5		
	21				12		
						Augered: 21.0-24.0	
	22					OVA: Oppm in hole	
	23						
	24						
				5	2	SS Run 5: 24.0-26.0	
10	25				2	1.83/2.0 recovery	
					3	OVA: Oppm on spoon	
	26				4	Oppm in hole	
						Augered: 26.0-29.0	
	27						
	28						
	29						
				6		SS Run 6: 29.0-31.0	
5	30					Shelby Tube Sample	
						from 29.0-31.0	
	31						
						Augered: 31.0-34.0	
	32					OVA: Oppm in hole	
	33						

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DRILLING LOG of WELL NO. MW-12-D — Page 3 of 3

State: Virginia — Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count	Remarks	Well Const.
0	34			7		1	SS Run 7: 34.0-36.0	
	35					2	1.83/2.0 recovery	
	36					2	OVA: Oppm on spoon	
	37					4	Oppm in hole	
	38						Augered: 36.0-38.0	
	39			8		3	OVA: Oppm in hole	
-5	40					2	SS Run 8: 38.0-40.0	
						2	1.83/2.0 recovery	
						2	OVA: Oppm on spoon	
							Oppm in hole	
							NOTE: Installed 6"ID low carbon steel casing to 14 ft	

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Ecology and Environment, Inc. — Buffalo, New York

DRILLING LOG of WELL No. MW-13-S

State	Virginia	Start Date	7/27/89
Location	Chuckatuck	Completion Date	7/27/89
Drilling Firm	GES Inc.	Ground Elevation	32.41
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	2.89 ▼
		after 60 days	3.75 ▼
Geologist	A. Ayuboha	Total Depth of Boring	18.0'
			Lock #

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Counts	Remarks	Well Const.
32.41		Ground Surface					Stickup = -0.14	
	1	0.0-2.0: SAND (SM): dark gray, sand and topsoil					HSA with split spoons for sampling Auger: 0.0-6.0 OVA: Oppm in hole	
30	2	2.0-3.0: SAND (SP): black, medium to fine grained						
	3	3.0-11.2: SAND (SW): white to gray, medium grained, wet						
	4							
	5							
	6			1		1 4 3 4	SS Run 1: 6.0-8.0 1.83/2.0 recovery OVA: Oppm on spoon Oppm in hole Auger: 8.0-10.0 OVA: Oppm in hole	
25	7							
	8							
	9							

*For rock coring = % Recovery (RQD)

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL NO. MW-13-S

State: Virginia Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count	Remarks	Well Const.
				2		2	SS Run 2: 10.0-12.0	
	11					4	1.83/2.0 recovery	
						2	OVA: Oppm on spoon	
	12	11.2-11.7: SAND (SW): white, quartzose, coarse				3	Oppm in hole	
20		to very coarse grained		3		7	SS Run 3: 12.0-14.0	
	13					7	1.83/2.0 recovery	
		11.7-12.3: SAND (SW): dark green, medium				1	OVA: Oppm on spoon	
	14	grained, may contain contaminants				1	Oppm in hole	
		12.3-17.0: SAND (SP): dark green, medium to fine		4		4	SS Run 4: 14.0-16.0	
	15	grained				1	1.25/2.0 recovery	
						1	OVA: Oppm on spoon	
	16					1	Oppm in hole	
				5		4	SS Run 5: 16.0-18.0	
	17					2	1.83/2.0 recovery	
15		17.0-18.0: SILTY SAND (SM): dark green, 20%				1	OVA: Oppm on spoon	
	18	silt, 20% clay at bottom				1	Oppm in hole	

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL No. MW-14-D

State	Virginia	Start Date	9/23/89
Location	Chuckatuck	Completion Date	9/28/89
Drilling Firm	GES Inc.	Ground Elevation	32.33
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	3.78 ▼
Geologist	A. Ayuboha	after 270 days	3.80 ▼
		Total Depth of Boring	26.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Counts*	Remarks	Well Const.
32.33		Ground Surface				Stickup = -0.45	
	1	0.0-12.7: SAND (SP): grayish white, medium to coarse grained, wet				HSA with split spoons for sampling Auger: 0.0-6.0 OVA: 1.5ppm in hole	
30	2						
	3						
	4						
	5						
	6			1	1	SS Run 1: 6.0-8.0	
					4	1.83/2.0 recovery	
25	7				3	OVA: 0ppm on spoon	
	8				4	1.5ppm in hole	
				2	3	SS Run 2: 8.0-10.0	
	9				2	1.83/2.0 recovery	
					4	OVA: 0ppm on spoon	
					5	1.5 in hole	

*For rock coring = % Recovery (RQD)

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL NO. MW-14-D

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count	Remarks	Well Const.
	11			3		9 7	SS Run 6: 10.0-12.0 1.83/2.0 recovery	
	12					8 9	OVA: Oppm on spoon 1-9ppm in hole	
20				4		1	SS Run 4: 12.0-13.0	
	13					0	1.00/2.0 recovery	
	14	12.7-15.0: CLAY/SILTY CLAY (CL): greenish gray, silty (<20%) with <10% sand					OVA: Oppm on spoon 1ppm in hole Shelby Tube: 13.0-15.	
	15						SS Run 5: 15.0-17.0	
		15.0-16.0: SAND (SW): gray to clear, coarse grained		5		2 5	1.83/2.0 recovery OVA: Oppm on spoon	
	16	16.0-26.0: SILTY SAND (SM): gray, white and gray shell fragments				7	1ppm in hole	
	17					11	Augered: 17.0-20.0	
15							OVA: 1ppm in hole	
	18						1.83/2.0 recovery	
	19						OVA: Oppm on spoon 1ppm in hole	
	20			6		2	SS Run 6: 20.0-22.0	
	21					3 3		
	22					4		
10							Augered: 22.0-24.0	
	23							
	24			7		3	SS Run 7: 24.0-26.0	
	25					2 4	1.83/2.0 recovery OVA: Oppm on spoon	
	26					5	Oppm in hole	
							NOTE: Installed 8"ID low carbon steel casing to 14 ft	

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL No. MW-15-S

State	Virginia	Start Date	5/22/90
Location	Chuckatuck	Completion Date	5/22/90
Drilling Firm	GES Inc.	Ground Elevation	41.17
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	▽
		after 30 days	7.10 ▼
Geologist	A. Ayubaha	Total Depth of Boring	14.0'
			Lock #

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Counts	Remarks	Well Const.
41.17		Ground Surface				Stickup = -0.16	
		0.0-0.8: GRAVEL (GM): road gravel and topsoil		1	1	NOTE: This point overlays WT-5	
40	1	0.8-5.7: SAND (SP): brown, fine to medium and fine grained, locally rusty colored			3	HSA with split spoons for sampling	
	2				2		
				2	2	SS Run 1: 0.0-2.0	
	3				5	1.75/2.0 recovery	
					12	OVA: 0ppm on spoon	
	4				12	3ppm in hole	
				3	10	SS Run 2: 2.0-4.0	
	5				4	2.0/2.0 recovery	
					5	OVA: 0.5-1ppm on spoon	
					2	1ppm in hole	
35	6	5.7-7.8: CLAY (CL): gray, stiff			3	SS Run 3: 4.0-6.0	
				4	3	1.67/2.0 recovery	
	7				5	OVA: 0ppm on spoon	
					10	2ppm in hole	
	8	7.8-8.4: SANDY CLAY (CL): gray, transitional			5	SS Run 4: 6.0-8.0	
				5	4	1.75/2.0 recovery	
	9				10	OVA: 0ppm on spoon	
		8.4-9.8: SAND (SP): gray, coarse grained, with some cobbles			10	1ppm in hole	
					6		

*For rock coring = % Recovery (RQD)

Saunders Supply Company

Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL NO. MW-15-S

State: Virginia Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks	Well Const.
				6		SS Run 5: 8.0-10.0 1.67/2.0 recovery OVA: Oppm on spoon 0.5-1ppm in hole	
30	11	9.8-10.0: CLAY (CL): greenish brown 10.0-10.75: CLAY and SAND (CL/SC): interfingering gray clay and clayey sand					
	12			7		SS Run 6: 10.0-12.0 2.0/2.0 recovery OVA: Oppm on spoon Oppm in hole	
	13	10.75-11.75: CLAY (CL): greenish gray, sticky					
	14	11.75-14.0: CLAY and SAND (CL/SC): interfingerings of gray clay, sand and sandy clay				SS Run 7: 12.0-14.0 2.0/2.0 recovery OVA: Oppm on spoon Oppm in hole	

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL No. MW-16-S

State	Virginia	Start Date	5/21/90
Location	Chuckatuck	Completion Date	5/21/90
Drilling Firm	GES Inc.	Ground Elevation	42.34
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	5.00 ▼
		after 0 days	8.60 ▼
Geologist	A. Ayuboha	Total Depth of Boring	12.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count*	Remarks	Well Const.
42.34		Ground Surface					Stickup = -0.14	
		0.0-0.33: SAND (SN): sand with 20% topsoil, vegetation and rootlets throughout		1		5	NOTE: This point	
	1					2	overlays WP-7	
						3	HSA with split spoons	
	2	0.33-6.0: SAND (SP/SC): brown to translucent				3	for sampling	
40		white, medium to fine grained with some clayey		2		1	SS Run 1: 0.0-2.0	
	3	sand, presence of black organics may indicate				1	2.0/2.0 recovery	
		fill material				1	OVA: Oppm on spoon	
	4	3.5-4: same as above but wet				2	off scale in hol	
				3		1	SS Run 2: 2.0-4.0	
	5					1	2.0/2.0 recovery	
		5.0: CLAYEY SAND LAYER				1	OVA: Oppm on spoon	
	6					1	off scale in hole	
		6.0-7.0: SAND and CLAY (SC/CL): interfingering		4		1	SS Run 3: 4.0-6.0	
	7	of brown medium to fine grained sand and (10%)				1	2.0/2.0 recovery	
35		black, organic-rich clay, sparse rootlets				2	OVA: Oppm on spoon	
	8					2	off scale in hole	
		7.0-7.5: SAND (SP): gray, medium to fine		5		1	SS Run 4: 6.0-8.0	
	9	7.5-8.0: CLAYEY SAND (SC): gray, trace black				2	2.0/2.0 recovery	
						3	OVA: Oppm on spoon	
		8.0-9.5: CLAY (CL): greenish gray, darker >8.3				4	off scale in hole	

*For rock coring = % Recovery (RQD)

Saunders Supply Company

Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL NO. MW-16-S

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count	Remarks	Well Const.
		9.0-9.5: same but trace sand		6			SS Run 5: 8.0-10.0 2.0/2.0 recovery	
	11						OVA: Oppm on spoon off scale in hole	
		9.5-11.0: SAND (SP): gray and black, medium to coarse grained, trace clay at top					SS Run 6: 10.0-12.0 2.0/2.0 recovery	
	12						OVA: Oppm on spoon off scale in hole	
		11.0-12.0: CLAY (CL): greenish clay and silty clay Yorktown confining unit					Spoon hole from 11.0 to 12.0 was sealed with bentonite pellets	

Saunders Supply Company

Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL No. MW-18-D

State	Virginia	Start Date	5/24/90
Location	Chuckatuck	Completion Date	5/25/90
Drilling Firm	GES Inc.	Ground Elevation	38.45
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	12.83 ▼
		after 30 days	17.70 ▼
Geologist	A. Ayuboha	Total Depth of Boring	27.0'
			Lock #

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Counts	Remarks	Well Const.
38.45		Ground Surface					Stickup = 2.04	
	1	0.0-1.0: SAND (SW): fine grained, top 2" of topsoil at top moist		1			HSA with split spoons for sampling	
	2	1.0-2.5: SAND (SW): gray, translucent, fine grained, moist		2			SS Run 1: 0.0-2.0 2.0/2.0 recovery OVA: Oppm on spoon 12ppm in hole	
35	3	2.5-4.0: CLAYEY SAND (SC): yellowish brown					SS Run 2: 2.0-4.0 2.0/2.0 recovery	
	4							
	5	4.0-5.4: SAND (SW): brownish gray to orange, medium grained		3		7 5 4	OVA: Oppm on spoon 12ppm in hole	
	6	5.4-6.0: CLAY (CL): gray, stiff, slightly sandy				5	SS Run 3: 4.0-6.0 2.0/2.0 recovery	
	7	6.0-6.75: CLAYEY SAND (SC): gray and brown, 820% clay		4		4 5	OVA: Oppm on spoon 12ppm in hole	
	8	6.75-12.0: SAND (SW): white, trace of rusty orange sand, fine grained		5		6 4 4	SS Run 4: 6.0-8.0 1.58/2.0 recovery OVA: Oppm on spoon 6ppm in hole	
30	9					3 4 4	SS Run 5: 8.0-10.0 1.83/2.0 recovery	

*For rock coring = % Recovery (RQD)

Saunders Supply Company

Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL NO. MW-18-D

State Virginia Location Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and Symbol	Blow Count	Remarks	Well Const.
	11			6	7 3 3 3	OVA: Oppm on spoon 2ppm in hole SS Run 6: 10.0-12.0 0.83/2.0 recovery	
	12						
25	13	12.0-13.8: SAND (SW): brown and rusty orange, medium grained, wet 12.8-13.0: Thin layer of gray clay		7	5 7 10	OVA: Oppm on spoon Oppm in hole SS Run 7: 12.0-14.0 1.83/2.0 recovery	
	14				5		
	15	13.8-14.4: CLAY (CL): orange with accumulation of oxidized iron and manganese (nodules), 10% silt		8	1 2	OVA: Oppm on spoon Oppm in hole	
	16	14.4-15.7: SANDY CLAY (CL): gray and orange 15.7-16.5: CLAY (CL): greenish black, @10% silt, @10% sand.			1 1	SS Run 8: 14.0-16.0 2.0/2.0 recovery	
	17					OVA: Oppm on spoon Oppm in hole 14.5-16.5: Yorktown Fm confining layer Augered: 16.0-27.0	
20	18	16.5-27.0: SILTY SAND (SM): green, abundant white and gray shell fragments (Yorktown Formation)					
	19						
	20						
	21						
	22						
	23						
15	24						
	25						
	26						
	27						

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Ecology and Environment, Inc. Buffalo, New York

DRILLING LOG of WELL No. MW-19-D

State	Virginia	Start Date	5/23/90
Location	Chuckatuck	Completion Date	5/25/90
Drilling Firm	GES Inc.	Ground Elevation	20.28
Type of Drill	CME 55	Groundwater Depth	
Driller	D. Pugh	at completion	6.00 ▼
Geologist	A. Ayuboha	after 30 days	3.80 ▼
		Total Depth of Boring	26.0'
		Lock #	

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count*	Remarks	Well Const.
20.28		Ground Surface					Stickup = 1.28	
20	1	0.0-2.6: SANDY FILL: gray and black, fine grained, trace of asphalt fill material		1			HSA with split spoons for sampling	
	2			2			SS Run 1: 0.0-2.0 1.0/2.0 recovery	
	3	2.6-4.0: GRAVEL FILL: black, mixed with @10% asphalt					OVA: Oppm on spoon >200ppm in hole	
	4						SS Run 2: 2.0-4.0 1.58/2.0 recovery	
	5	4.0-6.0: SANDY FILL: dark gray, fine to medium-fine sand, with trace asphalt fragments		3		1 1 1 1	OVA: Oppm on spoon >200ppm in hole SS Run 3: 4.0-6.0 0.5/2.0 recovery	
15	6							
	7	6.0-10.9: CLAY (CL): black, organic-rich clay, roots		4		1 1 0	OVA: Oppm on spoon >200ppm in hole SS Run 4: 6.0-8.0 1.33/2.0 recovery	
	8					0		
	9			5		1 1 1 3	OVA: 50-80ppm on spoon >200ppm in hole SS Run 5: 8.0-10.0 0.83/2.0 recovery	

*For rock coring = % Recovery (RQD)

Saunders Supply Company

Ecology and Environment, Inc. — Buffalo, New York

DRILLING LOG of WELL NO. [illegible]-12-D

State: Virginia Location: Chuckatuck

Elev.	Depth	Description	Lithology	Sample No. and	Symbol	Blow Count	Remarks	Well Const.
10	10			6		2	OVA: 50ppm on spoon	
	11					2	>200ppm in hole	
		10.9-14.0: CLAY (CL): green, slightly silty at top, Yorktown Formation confining unit				1	SS Run 6: 10.0-12.0	
	12					1	1.75/2.0 recovery	
				7		2	OVA: 5ppm on spoon	
	13					2	>200ppm in hole	
						2	SS Run 7: 12.0-14.0	
	14					2	0.83/2.0 recovery	
		14.0-15.5: CLAY/SANDY CLAY (CL): greenish gray, @20% sandy clay		8		1	OVA: 0ppm on spoon	
	15					1	10ppm in hole	
5						1	SS Run 8: 14.0-16.0	
	16	15.5-26.0: SILTY SAND (SM): gray, abundant white shells (Yorktown Formation)				2	1.83/2.0 recovery	
							OVA: 0ppm on spoon	
	17						5ppm in hole	
							Augered: 16.0-20.0	
	18						OVA: 1ppm in hole	
	19							
0	20			9			SS Run 9: 20.0-22.0	
	21						1.75/2.0 recovery	
							OVA: 1ppm on spoon	
	22						1ppm in hole	
				12			Augered: 22.0-26.0	
	23						OVA: 0.2ppm in hole	
	24						NOTE: Installed 8" ID low carbon steel casing to 8 ft	
-5	25							
	26							

Saunders Supply Company

Ecology and Environment, Inc. Buffalo, New York

SOIL LOGS FOR MONITORING WELLS

RUSSNOW-KANE

Source: NUS 1985b

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 1 OUR FILE NO. L-608-A-2

LOCATION Chuckatuck CLIENT'S ORDER

PROJECT Russnow-Kane SAMPLER S.S. CASING LENGTH DIA. DATE STARTED 5/13/82

SURF. ELEV. WATER ELEV: IMMEDIATE AFTER HRS. DATE COMPLETED 5/13782

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	2-2-3-4	2	2.0	Black and dark brown silty fine sand w/some med. sand and trace of organics - moist - loose - SP
		2	4-3-2-2	4		Med. brown fine sand w/some med. sand - moist - loose - SP
		3	2-2-2-3	6		Same - light brown - saturated
		4	2-3-3-5	8	8.5	Same - light brown - saturated
		5	2-1-3-6	10		Dark brown silty fine to med. sand w/sandy silt lenses and trace of gravel - saturated - loose - SM
		6	4-3-3	15		Same - dark brown and dark grey
		7	2-1-1	20	20.5	Same - dark grey
						Bottom of Boring 20.5'
				25		

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

McCallum Testing Laboratories, Inc.

BORING NO. 2 — CHESAPEAKE, VIRGINIA 23325 — OUR FILE NO. I-608-A-2

LOCATION Chuckatuck — LOG OF BORINGS — CLIENT'S ORDER

PROJECT Russnow-Kane SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____ DATE STARTED 5/13/82

SURF. ELEV. ____ WATER ELEV: IMMEDIATE ____ AFTER ____ HRS. ____ DATE COMPLETED 5/13/82

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	2-3-3-2	2		Med. brown fine sand w/some med. sand - moist - loose - SP
		2	2-1-1-1	4		Same - light brown - saturated
		3	5-7-7-8	6	6.0	Same - light brown w/some clay - wet
		4	4-5-5-6	8	7.5 8.0	Tan clayey fine to med. sand - wet - med. compact - SC Light grey fine sandy clay - wet - stiff - CL
		5	6-6-5-6	10	14.0	Med. brown fine to med. sand w/some clay - saturated - med. compact - SP
		6	2-1-4	15		Dark grey fine sandy silt - saturated - soft - ML
		7	2-2-4	20	20.5	Same - dark grey and olive green
						Bottom of Boring 20.5'
				25		

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 3 | OUR FILE NO. L-608-A-2

LOCATION Chickatuck | CLIENT'S ORDER

PROJECT Russnow-Kane | SAMPLER | S.S. | CASING LENGTH | DIA. | DATE STARTED 5/13/82

SURF. ELEV. | WATER ELEV: IMMEDIATE | AFTER | HRS. | DATE COMPLETED 5/13/82

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	3-2-2-2	2		Med. brown fine sand w/some med. sand - moist - loose SP
		2	2-1-1-2	4		Same - light brown - wet
		3	5-5-9-7	6		Same - light brown - wet
		4	3-2-2-4	8	6.5	Light brown fine sandy clay w/some med. sand - wet - med. stiff - CL
		5	6-7-7-9	10	8.0	Light brown fine to med. sandy clay w/some coarse sand - wet - stiff - CL, SC
		6	4-4-7	15	14.5	Tan fine to med. sand w/little silt - saturated - loose - SP
		7	5-4-5	20	19.0	Light brown clayey fine to med. sand - saturated - loose - SC
				25	20.5	Bottom of Boring 20.5'

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 4 | OUR FILE NO. I-608-A-2

LOCATION Chuckatuck | CLIENT'S ORDER

PROJECT Russnow-Kane | SAMPLER | S.S. | CASING LENGTH | DIA. | DATE STARTED 5/13/82

SURF. ELEV. | WATER ELEV: IMMEDIATE | AFTER | HRS. | DATE COMPLETED 5/13/82

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	2-3-4-5	2		Med. brown fine sand w/some med. sand - moist - loose - SP
		2	2-1-1-1	4		Same - light brown - saturated
		3	2-2-3-4	8		Same - light brown - saturated
		4	2-3-5-5	8	7.0	Light brown fine to med. sandy clay - saturated - med. stiff - CL
		5	5-7-7-8	10	9.5	Med. brown and light grey clayey fine to med. sand w/trace of silt - saturated - med. compact - SC
		6	4-4-4	15	15.0	Dark grey silty fine to med. sand w/sandy silt lenses - saturated - loose - SM
		7	5-7-7	20	20.5	Same - olive green w/trace of shell fragments
				25		Bottom of Boring 20.5'

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

SOIL LOGS AND MONITORING WELL CONSTRUCTION DETAILS FOR PEMBROKE WELLS P-1 AND P-2

Source: Henningson, Durham, and Richardson 1984; NUS 1985b; Werner 1991.

P-1

9 State law requires submitting to the Virginia State Water Control Board information about groundwater and wells for every well made in the State intended for water, or any other non exempt well. This information must be submitted whether the well is completed, on standby or abandoned. Information required includes an accurately and completely prepared water well completion report, full data from any aquifer pumping tests, drill cuttings taken at ten foot intervals (unless exemption is secured), the results of any chemical analyses and copies of any geophysical logs. Quarterly pumpage and use reports are required from owners of public supply and industrial wells. County or State permits to drill may be required in some parts of the state. Some counties require submission of a water well completion report. The Virginia State Health Department requires a water well completion report for public supply wells.

Well P-1

10. DRILLERS LOG (use additional Sheets if necessary)

DEPTH (feet) From	DEPTH (feet) To	TYPE OF ROCK OR SOIL (color, material, fossils, hardness, etc.)	REMARKS (water, caving cavities, broken, core, shot, tests)	11 Drilling Time (Min.)	12 DIAGRAM OF WELL CONSTRUCTION (with dimensions)
0	10	Red-brown clay			
10	70	Sandy gray clay, shells, shellrock			
70	72	Gray and green clay			
72	85	Black shells			
85	90	Mostly shells and some black sand			
90	95	Black sand and shells			
95	100	Mostly fine sand and shells			
100	106	Fine sand			
106	125	Fine sand and shell streaks			

13. Well lot dedicated? _____ Size _____ ft X _____ ft. Well house? _____
Distance to nearest pollutant source _____ ft. Type _____
Distance to nearest property line _____ ft. Building _____ ft.

14 WATER SERVICE PIPE Checked under _____ psi for _____ minutes. Pipe size _____ inches, Material _____
Installer _____
Date _____

15. I certify that the information contained herein is true and correct and that this well and/or system has been installed and constructed in accordance with the requirements for well construction as specified in compliance with appropriate county or independent city ordinances and the laws and rules of the Commonwealth of Virginia.

Signature _____ (Seal) Date 9/23/83
(Well driller or authorized person)

License No _____

State Water Control Board Regional Offices

Valley Reg. Off.
116 North Main Street
P. O. Box 268
Bridgewater, Va. 22812
703 828 2595

Piedmont Reg. Off.
4010 West Broad Street
P. O. Box 6616
Richmond, Va. 23230
804 257-1006

Southwest Reg. Off.
408 East Main Street
P. O. Box 478
Abingdon, Va. 24210
703 628-5183

Tidewater Reg. Off.
287 Pembroke Office Park
Suite 310 Pembroke No. 2
Va. Beach, Va. 23462
804-499-5742

West Central Reg. Off.
Executive Park
5312 Peters Creek Road
Roanoke, Va. 24019
703 - 982 - 7432

Northern Virginia Reg. Off.
5515 Cherokee Avenue
Suite 404
Alexandria, Va. 22312
703-750-9111

78-10.000

WATER WELL COMPLETION REPORT

(Certification of Completion/County Permit)

*SWCM No

P-1

ate Water Control Board
O. Box 11143
11 North Hamilton St.
ichmond, Va. 23230

SWCB Permit
County Permit
Certification of inspecting official:
This well does ____ does not ____ meet code/law requirements.
S.
Date
For Office Use

unty/City
County/City Stamp

Virginia Plane Coordinates
N
E
Latitude & Longitude
N
W
Topo. Map No.
Elevation ft.
Formation
Lithology
River Basin
Province
Type Logs
Cuttings
Water Analysis
Aquifer Test

*Owner City of Suffolk
*Well Designation or Number Chuckatuck Shallow Well P-1
Address P.O. Box 1858
Suffolk Virginia 23434
Phone 804-934-3111

*Drilling Contractor Sydnor Hydrodynamics, Inc.
Address P.O. Box 27186
Richmond, Virginia 23261
Phone 804-643-2725

Tax Map I.D. No.
Subdivision
Section
Block
Lot
Class Well I ____, IIA ____, IIB ____, IIIA ____, IIIB ____, IIIC ____, IIID ____, IIIE ____

WELL LOCATION: 1.3 (feet/miles) East (direction) of Rt 10 (Chucatuck, Va.)
and 60 feet/miles N. (direction) of Pembroke Lane
(If possible please include map showing location marked)

Date started 08/22/83 * Date completed 09/26/83 Type rig Rotary

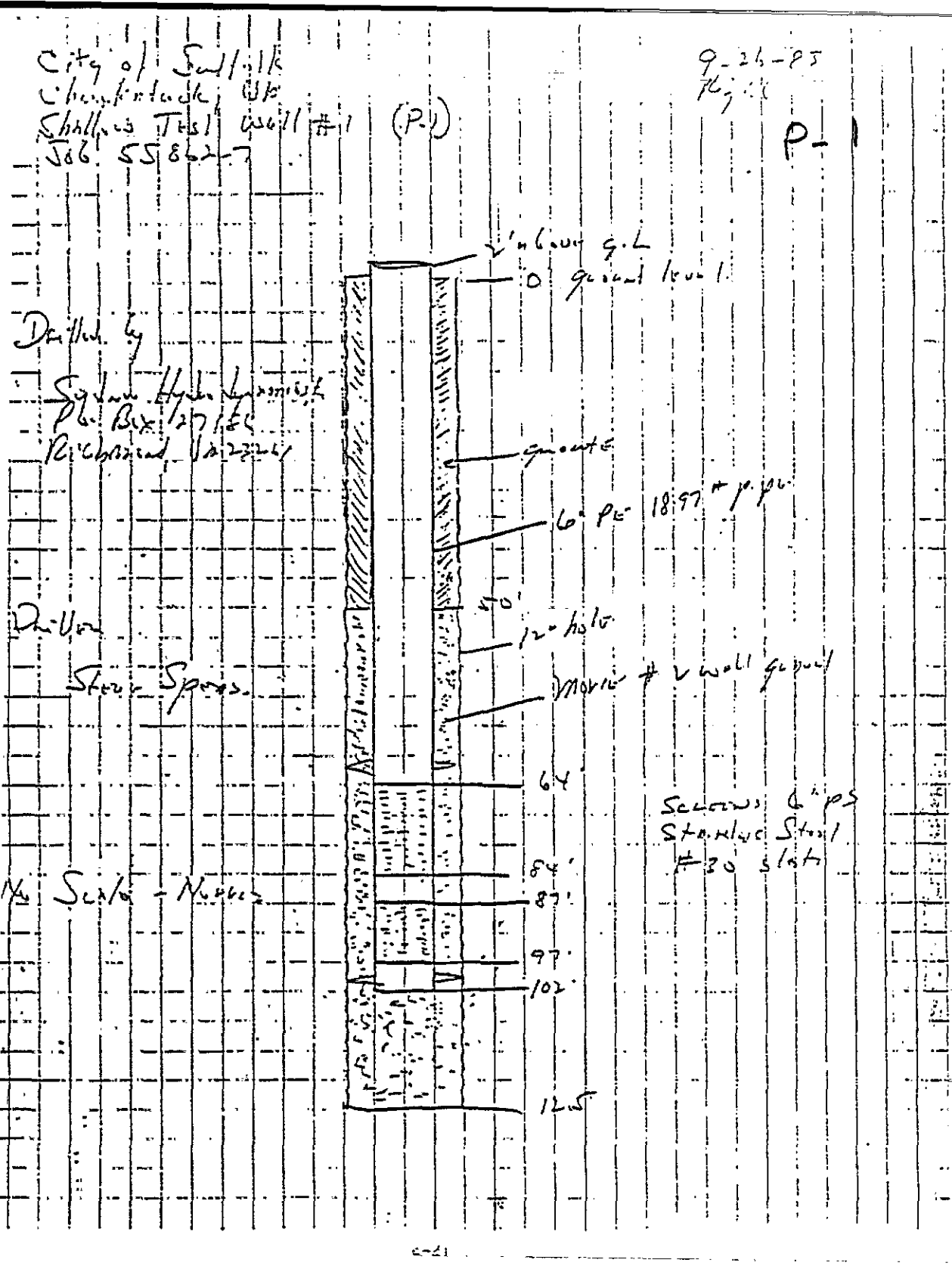
WELL DATA: New * Reworked ____ Deepened ____
Total depth 125 ft.
Depth to bedrock ____ ft.
Hole size (Also include reamed zones)
* 12 inches from 0 to 125' ft.
* ____ inches from ____ to ____ ft.
* ____ inches from ____ to ____ ft.
Casing size (I.D.) and material
* 6 inches from +2 to 64 ft.
Material Steel
Wt. per foot 18.97 or wall thickness ____ in.
* 6 inches from 84 to 87 ft.
Material Steel
Wt. per foot 18.97 or wall thickness ____ in.
* 6 inches from 97 to 102 ft.
Material Steel
Wt. per foot 18.97 or wall thickness ____ in.
Screen size and mesh for each zone (where applicable)
* 6 inches from 64 to 84 ft.
*Mesh size #30 Type Stainless Steel
* 6 inches from 87 to 97 ft.
*Mesh size #30 Type Stainless Steel
* ____ inches from ____ to ____ ft.
*Mesh size ____ Type ____
* ____ inches from ____ to ____ ft.
*Mesh size ____ Type ____
Gravel pack
*From 50 to 125 ft.
*From ____ to ____ ft.
Grout
*From 0 to 50 ft., Type Cement
*From ____ to ____ ft., Type ____

2. WATER DATA *Water temperature ____ °F
*Static water level (unpumped level measured) 17'5½" ft
*Stabilized measured pumping water level 36'4½" ft
*Stabilized yield 150 gpm after 48 hours
Natural Flow. Yes ____ No * , flow rate ____ gpm
Comment on quality Attach Analysis
3. WATER ZONES: From 64 To 84
From 87 To 97 . From ____ To ____
From ____ To ____ . From ____ To ____
4. USE DATA:
Type of use: Drinking ____ . Livestock Watering ____
Irrigation ____ Food processing ____ . Household ____
Manufacturing ____ . Fire safety ____ . Cleaning ____
Recreation ____ . Aesthetic ____ . Cooling or heating ____
Injection ____ . Other Test Well
*Type of facility: Domestic ____ . Public water supply *
Public institution ____ Farm ____ . Industry ____
Commercial ____ . Other ____
5. PUMP DATA: Type ____ *Rated H.P. ____
*Intake depth ____ *Capacity ____ at ____ head
6. WELLHEAD: Type well seal ____
Pressure tank ____ gal., Loc. ____
Sample tap ____ Measurement port ____
Well vent ____ , Pressure relief valve ____
Gate valve ____ , Check valve (when required) ____
Electrical disconnect switch on power supply ____
7. DISINFECTION: Well disinfected ____ yes ____ no
Date ____ . Disinfectant used ____
Amount ____ . Hours used ____
8. ABANDONMENT (where applicable) *yes ____ no ____
Casing pulled yes ____ no ____ not applicable ____
Plugging grout From ____ to ____ material ____

E-15

B-91

AR301618


City of Suffolk
Shallow Test Well #1 (P-1)
VDH 55862-7
9-24-85
P-1
Drilled by
Layne Hydro Dynamics
P.O. Box 27165
Richmond, VA 23261
Driven
Steel Specs.
No Scale - Notes
1' above G.L.
0 ground level
grout
6" PE 18.97 # per ft.
40'
12" hole
Morie # 1 well screen
64'
84'
87'
97'
102'
125'
Screens 6" ps
Stainless Steel
#30 slot

Eg. & Boring Company, Inc.

WELL LOG

P-2

City of Suffolk, Va. NK-0589

Feet		Feet	Description
0	to	8	brown & yellow clay, hard
8	to	16	grey & white sand
16	to	18	yellow clay
18	to	26	white & grey sand
26	to	40	white & grey sand
40	to	42	yellow clay, hard
42	to	52	grey sand, traces of shells
52	to	62	med. grey sand, more shells than above
62	to	72	med to coarse sand, some clay, more shells than above
72	to	82	med to coarse sand & shells, some blue clay
82	to	92	fine sand & shells, blue clay
92	to	102	fine silty sand & some shells , traces of blue clay
102	to	127	fine silty black pepper sand & traces of shells

FORM GW-4
10/76 300

COMMONWEALTH OF VIRGINIA
STATE WATER CONTROL BOARD
P. O. Box 11143, 2111 North Hamilton Street
Richmond, Virginia 23230
Phone (804) 786-1411

P-2

REGISTRATION STATEMENT

(For Use in Critical Groundwater Areas)

OWNER'S WELL NO.: 103.1.2.4
SWCB REGISTRATION NO.: _____
DATE RECEIVED: 12/24/86

RECEIVED NOV 26 1986 Tidewater Regional Office

SECTION 1
GENERAL:

This REGISTRATION STATEMENT, pursuant to Section 62.1-44.99, Chapter 3.4, Title 62.1, is filed with the State Water Control Board as evidence that the person named hereon, as owner, does hereby claim the right to use groundwater as described and sworn to (One Registration Statement shall be completed and filed for each water well owned by the person named hereon.)

OWNER: City of Suffolk
ADDRESS: Post Office Box 1858
Suffolk, VA 23434

PHONE: (804) 934-3111, Ext. 292

SECTION 3
WELL CONSTRUCTION DATA:

1. Total depth of water well 125 feet (If drawing of well to be or as constructed and installed is available, furnish such drawing herewith and omit data requested in this section).

2. Water well contractor who constructed or is constructing the above well:

NAME: Layne Atlantic Company
ADDRESS: 3322 Cromwell
Norfolk, VA 23509

3. DATE COMPLETED: 3/84
or day/mo./yr.
DATE OF EXPECTED COMPLETION: _____ day/mo./yr.

4.

HOLE SIZE:	CASING SIZE
12 in. from 0 to 125 ft.	6 in. from 12 to 64 ft.
___ in. from ___ to ___ ft.	6 in. from 84 to 87 ft.
___ in. from ___ to ___ ft.	6 in. from 97 to 102 ft.
___ in. from ___ to ___ ft.	___ in. from ___ to ___ ft.
WATER ZONES:	**SCREENS:**
from ___ to ___ ft.	6 in. from 64 to 84 ft.
from ___ to ___ ft.	6 in. from 87 to 97 ft.
from ___ to ___ ft.	___ in. from ___ to ___ ft.

SECTION 2
GROUNDWATER USE:

The following section will be used as a guide for determining owner's rights to apply groundwater to a beneficial use under Section 62.1-44.93

Instructions:

1. State maximum pumpage figure for the above well. Maximum pumpage means the maximum pumpage on any given day within two (2) years prior to the date of declaration of the critical groundwater area.
Maximum pumpage from this single well = 185,700 gallons per day on 17/7/85 date. day/mo./yr.

2. State maximum pumpage figure for entire well system*
Maximum pumpage from well system = 462,100 gallons per day on 17/7/85 date. day/mo./yr.

*Note:
A REGISTRATION STATEMENT must be filed for each well within a well system. Instruction No. 1 will indicate pumpage for one well. Instruction No. 2 will indicate total system pumpage for all wells and will remain the same and be repeated on each REGISTRATION STATEMENT.

Water well located in Suffolk city/~~county~~ in Southeastern critical groundwater area, approximately 1.28 ~~feet~~/miles E (direction) of Rt. 10 and 60 ~~feet~~/~~miles~~ N (direction) of Pembroke.

Was well in operation prior to declaration of critical groundwater area? Yes or (No) (circle)

Was well under construction at the ~~time~~ of declaration of critical groundwater area? Yes or (No) (circle)

AR301621

NORFOLK, VA.

P-2

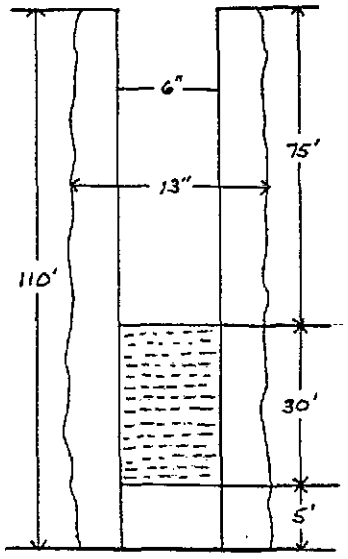
LOG OF WELL For City of Suffolk

Located at Pembroke Road H0.2 in Chuckatuck County, State Virginia

Date Drilling Started 1/2?/84 19 Date Started 12/28/83 19

Finished Drilling 3/9/84 19 Finished 4/23/84 19

FORMATIONS AND DEPTH OF WELL					DIMENSIONS OF CASING AND SCREEN						
TOTAL DEPTH OF ALL STRATA		DEPTH OF EACH STRATUM		FORMATION FOUND AT EACH STRATUM	TOTAL LENGTH OF ALL SCREENS and CASINGS		LENGTH OF EACH SEC. OF SCREEN OR CASING		SPECIFY SCREEN OR CASING	SIZE OF SCREEN OR CASING	GAUGE OF SCREEN
FT.	IN.	FT.	IN.		FT.	IN.	FT.	IN.		IN.	
8		8		brown & yellow clay, hard	75		75		casing	6	
16		8		grey & white sand	30		30		screen	6	.012
18		2		yellow clay	80		5		casing	6	
40		22		white & grey sand							
42		2		yellow clay, hard							
52		10		grey sand, traces of shells							
62		10		med. grey sand, some blue clay, more shells than above							
72		10		med. to coarse sand, some clay, more shells than above							
82		10		med to coarse sand & shells, some blue clay							
92		10		fine sand & shells, blue clay							
102		10		fine silty sand & some shells, traces of blue clay							
127		25		fine silty black pepper sand & traces of shells							



WELL DATA:

Preliminary Test

Date Tested 19 Static Level

Production GPM Pumping Level

Permanent Test

Date Tested 19 Static Level

Production GPM Active St. Level

Drawdown Pumping Level

Remarks:

PUMP DATA:

Shop No. Type Lubr.

Type Head Size Suction

Depth Setting (BP to MB)

Size Column Length Suction

Type Bowl Length Air Line

No. Stages Discharge-

Cap'y and Head Pressure

MOTOR DATA:

Horsepower Voltage

RPM Phase

Type Cycles

Make Frame No.

B-95

APPENDIX C

CONTACT REPORTS

RUSSNOW KANE ASSOCIATES, INC.
LETTER

RussnowKane & Associates inc.
Geological, Soils and Environmental Consultants

April 22, 1991
Ref: #3357

Mr. Andrew Palestini
US EPA
841 Chestnut Building
Philadelphia, PA 19107

RE: Saunders Supply Co.

Dear Mr. Palestini:

Enclosed is the old test boring information you requested. Please be advised that this data has been previously forwarded to EPA and the RI/FS contractor. Based on the logs for Holes 1-5 (4-5 on the Kelly Property), a good clay lens was not encountered at #1, in the burn pit area. Also, please be advised that well points were in place near the property line at the time these borings were made.

The second set of handwritten logs is for the existing NPDES monitor wells. The logs describe depth drilled and depth constructed. The SWCB remembered these resulting in some confusion. The 1991 number should be correct.

Should you have any questions, please give me a call.

Very truly yours,
RUSSNOW-KANE & ASSOCIATES

Arthur L. Russnow, CPG
Vice President

ALR/jad
Enclosures
cc: David Ledbetter, Esq. w/encl.
Sam Howell, w/o encl.

AR301626

11524 Jefferson Avenue, Newport News, Virginia 23601 804-595-5561
AR301626

BORING LOG

Location: Saunders Supply
Contractor: Russrow-Kane & Assocs, Inc.
Structure:
Geologist: ALR & JLD
Engineer:
Comm. No. 3357
Sheet 1 of 1
Boring No. OW-1
Date 11/4/86

STRATA CHANGE DEPTH ELEV.	SAMPLE DEPTH FROM – TO	BLOWS PER 6" ON SAMPLER FROM – TO 0-6	6-12	12-18
	0-.5'			
	.5-5.34'			

DRILLER'S LOG ☐ GEOLOGIST'S LOG ☐
MECHANICAL ANALYSIS ☐

Leaf Litter

Grey and brown fine to medium grained sand; caved in past bottom of hole; wet.

1991 VA PDES No. OW-1

Down Grad. Pond
5.35' deep - total

REMARKS

WELL DATA

Total Depth: 5.34'
Casing I.D., Type: 2" Threaded
Range Slotted: 2.34' to 5.34'
Range Sand Packed:
Seal Type: To be sealed
Range Sealed:
Casing Stick-up: 3.27'
Elevation (T.O.C.):

GROUND WATER

Depth (G.S.): .10'
Elevation:
Date: 3/19/87 Time: 11:00 AM

Depth (G.S.):
Elevation:
Date: Time:

Depth (G.S.):
Elevation:
Date: Time:

OTHER COMMENTS

Hole hand-augered

BORING LOG

Location: Saunders Supply
Contractor: McCallum Testing Lab
Structure:
Geologist: R. Douglass
Engineer:
Comm. No. 3357
Sheet 1 of 1
Boring No. MW-1
Date 8/21/86

STRATA CHANGE DEPTH ELEV.	SAMPLE DEPTH FROM – TO	BLOWS PER 6" ON SAMPLER		
	0-2'	1	2	2
	2-4'	2	1	1
	4-6'	woh	1	1
	6-8'	woh	1	2
	8-10'	2	2	1
	14.0-15.5	2	3	2
	19.0-20.5	2	4	7
	24.0-25.5	3	5	15

DRILLER'S LOG ☐ GEOLOGIST'S LOG ☑ MECHANICAL ANALYSIS ☐

0-0.5' Topsoil
0.5-2.0' Yellowish brown silty fine to medium-grained sand; trace of gravel
2.0-4.0' same
4.0-6.0' same
6.0-6.5' same
6.5-8.0' dark grayish brown organic sandy clay
8.0-9.5' same
9.5-10' brownish gray silty fine grained sand
Dark greenish to bluish gray clay
Greenish gray sandy silty clay with shell fragments
Greenish gray silty clayey sand with shell fragments

VaSWCB re-numbered 1991 VAPDES No 000-3
Down Grad. Yard
Near Route 10

REMARKS

WELL DATA

Total Depth: 15'
Casing I.D., Type: 2" PVC Thr
Range Slotted: 5-15'; .015" Sl.
Range Sand Packed: 4-15'
Seal Type: Portland Cement
Range Sealed: 0-4'
Casing Stick-up:
Elevation (T.O.C.):

GROUND WATER

Depth (G.S.): 3.25' (TOC
Elevation:
Date: 8/22/86 Time: 11:00A

Depth (G.S.): 4.22' (TOC
Elevation:
Date: 8/25/86 Time:

Depth (G.S.):
Elevation:
Date: Time:

OTHER COMMENTS

Cased well redrilled to 15' and set above gray clay.

BORING LOG

Location: Saunders Supply
Contractor: McCallum Testing Lab
Structure:
Geologist: J.L. Douglass
Engineer:

Comm. No. 3357
Sheet 1 of 1
Boring No. MW-2
Date 8/21/86

STRATA CHANGE DEPTH ELEV.	SAMPLE DEPTH FROM – TO	BLOWS PER 6" ON SAMPLER			DRILLER'S LOG ☐ GEOLOGIST'S LOG ☑ MECHANICAL ANALYSIS ☐
	0-2'	2	2	5	2
	2-4'	2	2	5	4
	4-6'	2	3	5	9
	6-8'	5	10	11	12
	8-10'	5	1	4	2
	14-15.5'	3	5	5	
	19-20.5'	2	3	4	
	24-25.5'	2	5	5	

0-1.0' Topsoil
1.0-1.5' Dark brown silty fine-grained sand
1.5-2.0' Light yellowish brown silty fine-grained sand
2.0-4.0' same
4.0-6.0' Reddish brown and yellowish brown fine to coarse grained sand some; little silt
6.0-8.0' same
8.0-8.5' same
8.5-10.0' Brown silty fine to medium-grained sand
10.0-14.0' same
14.0-14.5' same
14.5-15.5' Light bluish grey clayey fine grained sand
15.5-19.0' same
19.0-19.5' same
19.5-20.5' Grey silty sandy clay
20.5-24.0' same
24.0-24.5' same
24.5-25.5' silty clayey fine-grained sand and shell fragments

Va SWCB Re-Numbered
1991 VAPDES NO OW 4
Up Grad. Yard

REMARKS

WELL DATA

Total Depth: 19'
Casing I.D., Type: 2" PVC
Range Slotted: 9-19': .015
Range Sand Packed: 6-19'
Seal Type: Portland Cem
Range Sealed: 0-6'
Casing Stick-up: 0.64'
Elevation (T.O.C.):

GROUND WATER

Depth (G.S.): 5.70'
Elevation:
Date: 8/22/86 Time: 11:0

Depth (G.S.): 5.50'
Elevation:
Date: 8/25/86 Time:

Depth (G.S.):
Elevation:
Date: Time:

OTHER COMMENTS

Location: Saunders Supply
Contractor: McCallum Testing Lab

BORING LOG
Structure
Geologist: JL Douglass
Engineer

Comm. No. 3357
Sheet 1 of 1
Boring No. MW-J
Date 8/21/86

DRILLER'S LOG ☐ GEOLOGIST'S LOG ☑ MECHANICAL ANALYSIS ☐

STRATA CHANGE DEPTH ELEV.	SAMPLE DEPTH FROM – TO	BLOWS PER 6" ON SAMPLER		
	0-2'	2/2	5	12
	2-4'	2/2	5	4
	4-6'	2/3	5	9
	6-8'	5/10	11	12
	8-10'	5/8	4	2
	140-155'			

0-.33' Topsoil
.33'-2.0' Yellowish brown silty, fine grained sand; trace of clay.
some;
some; wet
some; wet
1.5- Light grey and reddish brown clayey fine to coarse grained sand.
9.5-10.0'
14.0-15.0' Dark bluish grey clay
15.0-15.5' Dark bluish grey clayey sand - sandy clay.

Va SWCB re-Numbered
1991 VaPDES No. OW-2

Down Grad. Plant
Located between plant and pond

REMARKS

WELL DATA

Total Depth: 140'
Casing I.D., Type: 2" PVC, Thr
Range Slotted: 4-14'; 015' S
Range Sand Packed: 3.5-14
Seal Type: Portland Cement
Range Sealed: 0-3.5'
Casing Stick-up: 1.87'
Elevation (T.O.C.):

GROUND WATER

Depth (G.S.): 6.45'
Elevation:
Date: 8/22/86 Time: 11:10 a

Depth (G.S.): 6.33'
Elevation:
Date: 8/25/86 Time:

Depth (G.S.):
Elevation:
Date: Time:

OTHER COMMENTS

Muckatuck

Boring 1

S# 1, 0-2' — Dark brown to black fine to medium grained sand; at 1' color change to a lighter dark brown odorless
HB ?-2-3-4

S# 2, 2-4' — Medium brown medium grained sand w/ odor
HB 4-3-2-2

S# 3, 4-6' — Tan to gray medium ~~grained~~ Sand, some medium grav gravel, odorless wet
HB 2-2-2-3
Ch 4.5' wet @ 4.5

S# 4, 6-8' — Tan fine to medium grained sand slight odor
HB 2-3-3-5

S# 5, 8-10' — Dark brown to dark gray clayey medium to coarse grained sand
HB 2-1-3-6
Ch 8.5'

S# 6, 14-15.5' — below 15'
HB 4-3-3 — Dark brown and dark gray ~~fine~~ medium grained silty sand w/ small amt of clay.
Ch 15'

S# 7 19-20.5' — Same
HB 2-1-1

Key 1

0-1'; Dark brown to black fine to medium grained sand. Very strong odor.

1-8.5'; Tan to gray fine to medium grained sand. Wet below 4.5'. Strong odor decreasing with depth.

8.5'-15'; Dark brown to dark gray clayey medium to coarse grained sand.

15.0'-20.5'; ~~Dark brown~~ to dark gray slightly clayey silty fine to medium grained sand ~~with small amount of clay~~.

Shackelford

Boring 2

#1, 0-2'
B 2-3-3-2
Medium brown to tan fine to med grained sand

#2, 2-4';
B 2-1-1-1
Light brown to tan fine to med grained sand wet at 3'

#3 -4-6'
B 5-7-7-8
Light brown to tan slightly silty fine to medium grained sand

#4 6-8'
B 4-5-5-6
Rusty brown silty medium grained sand
7.5'
Gray ~~clayey~~ clay with trace of silt
Cl 7.5

#5 8-10'
B 6-6-5-6
8.5'
Gray slightly silty fine to medium grained sand
Cl 8.5'

#6 14-15.5'
B 2-1-4
15'
Dark gray slightly clayey silty fine to med grained sand becoming finer grained with depth
Cl 15'

#7 19-20.5'
B 2-2-4
Same only fine grained sand

Boring 2

0-6';
Medium brown to pale brown (tan) fine to medium grained sand. Wet at 3'. Becomes slightly silty with depth.

;-7.5'
Rusty brown silty medium grained sand

5-8.5'
Gray clay with a trace of silt

:5-15'
Gray slightly silty fine to medium grained sand

-20.5';
Dark gray slightly clayey, silty fine to med. grained sand. Becomes finer grained with increase in depth.

Shuckatuck

Boring 3

3 #1	0-2'	Pale brown (tan) fine to med grained sand
1B	3-2-2-2	
#2	2-4'	~~Pale~~ Same as above
B	2-1-1-2	
#3	4-6'	Same as above
B	5-5-9-7	
	~~Ch 4.5~~	
#4	6-8' 6.5'	Light gray slightly silty clay
B	3-2-2-4	
#5	8-10' 8	Pale brown to gray slightly clayey med grained sand
B	6-7-7-9	
	Ch 8	
#6	14-15.5'	rusty brown med-coarse grained sand with slight trace of clay
B	4-4-7	
	Ch 14.5'	
#7	19-20.5'	Pale brown to gray slightly clayey med. grained sand.
B	5-4-5	
'	- 6.5'	Pale brown fine to medium grained sand
.5	- 8.0	Light gray slightly silty clay
.0	- 20.5'	Pale brown to gray slightly clayey medium grained sand. @ 14', a lense of rusty brown medium to coarse grained sand with a slight trace of clay was encountered.

Duckatuck

Boring 4

#1 0–2 Pale brown to light gray fine to medium grained sand
3 2-3-4-5

#2 2–4 Pale brown fine to medium grained sand wet
2-1-1-1

#3 4–6 Light gray medium grained sand
3 2-2-3-4
Ch 5.5

#4 6–8' 7' ~~Dk~~ gray ~~slightly~~ silty clay
3 2-3-5-5
Ch 7'

#5 8–10' 9'10" Pale brown ~~fine~~ fine to med grained sand
3.5-7-7-8
Ch 9'10"

#6 14–15.5' 15'
3 4-4-4 Dark gray ~~sl~~ slightly clayey, silty fine to medium grained sand

#7 19–20.5' Same as above
3.5-7-7

Wet at 2'

0–7'; Pale brown to light gray fine to medium grained sand
7–9.8'; Light gray silty clay
9.8–15'; Pale brown fine to medium grained sand
15–20.5'; Dark gray slightly clayey, silty fine to medium grained sand.

Chuckatuck

Boring 5

S#1 0-2' Yellow brown sandy clay w/ several thin
B 1-2-1-2 lenses of fine grained sand
T.S. 10"

3.6

S#2 2-4' Yellow brown sandy clay grading to clayey sand
B 3-3-3-3 w/ lenses of fine grained sand

4.0

#3 4-6 Light gray to tan sandy clay
B 4-4-3-3
Ch 4'

— 6.0' —

#4 6-8' Light gray to tan f- m grained sand
B 4-4-4-5

#5 8-10' Same as above
B 4-5-7-9
wet 8.5

— 14' —

#6 14-15.5' (orange-brown) Light rust-colored fine to medium grained
B 5-5-9 sand

M 19-20.5' Medium to dark gray silty fine grained
B 3-3-6 19.5' sand w/ fossil fragments
Ch 19.5' (? Yorktown or reworked Yorktown)

Boring 8

0-3.0'; Yellow-brown sandy clay with several thin lenses of fine-grained sand

3.0-4.0'; Yellow-brown clayey sand with thin lenses of fine grained sand

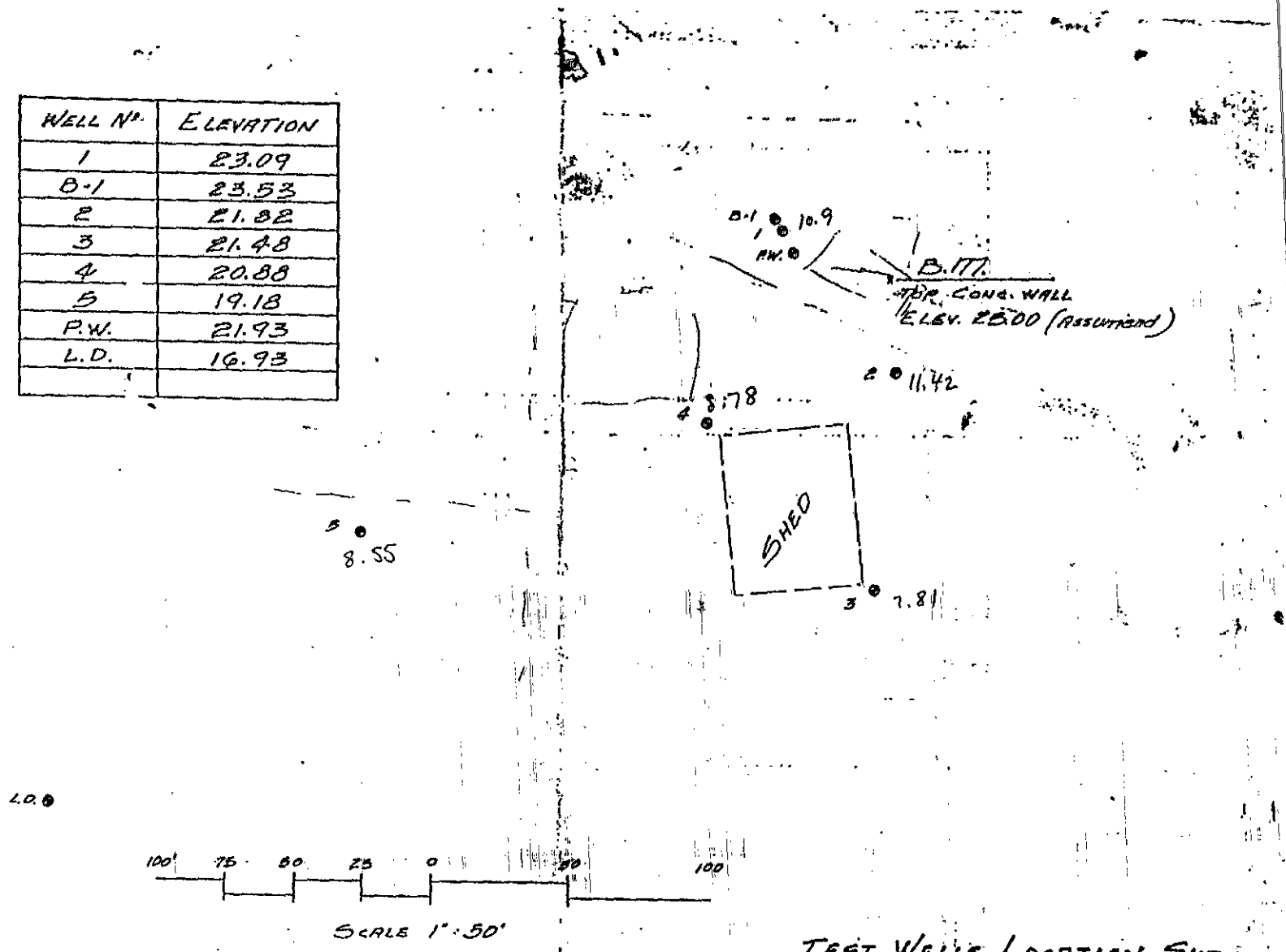
4.0-6.0'; Light gray to pale brown sandy clay

6.0-14.0'; Light gray to pale brown fine to medium grained sand wet at 8.5'

14.0-19.5'; Light orange-brown fine to medium grained sand

19.5-20.5'; Medium to dark gray silty fine grained sand with fossil fragment (? Yorktown or reworked Yorktown)

WELL Nº.	ELEVATION
1	23.09
B-1	23.53
2	21.82
3	21.48
4	20.88
5	19.18
P.W.	21.93
L.D.	16.93



TEST WELLS LOCATION SURVEY
LUMBER YARD
CHUCKATUCK
VIRGINIA
DEC. 28, 1982

C-14

AR301636

...B. 11, PG. 50

CONTACT REPORTS:
DRINKING WATER WELL INFORMATION

CONTACT REPORT

Meeting [ ] Telephone [] Other [ ]

AGENCY: Suffolk Department of Health

ADDRESS:

PHONE NO.: 804-925-2300

PERSON CONTACTED: Calvin Jones

TO: Fred McKosky

FROM: Jone Watson

DATE: April 5, 1991

SUBJECT: Residential Wells near Saunders

CC: Mary McHugh, ZD3081

The City of Suffolk is an independent city; there is no county jurisdiction. Most of that area is on city water supply. Wells have only been required to be permitted as of 9/90. However, he will check his records to identify any residential wells closer to SSC site than the 1.2 mi. identified in the HRS score. He will prepare a letter responding to our request for information by the first part of next week.

oio/ZD3981
[ENV]D1446

CONTACT REPORT

Meeting [ ] Telephone [X] Other [ ]

AGENCY: Suffolk Department of Health
Environmental Health Section

ADDRESS:

PHONE NO.: 804-925-2300

PERSON CONTACTED: Calvin Jones, Sanitarian Supervisor

TO: Fred McKosky

FROM: Jone Watson

DATE: April 11, 1991

SUBJECT: Residential Wells near Saunders

CC: Mary McHugh, ZD3081

C. Jones has not completed the search of residential wells. He plans to complete it today or tomorrow.

So far, he has found two wells closer than 1.2 miles from the site:

1) 184 Brown Lane, 566 ft deep, 10/89, @3,000 ft away.
2) 200 Brown Lane, 490 ft deep, 1/85, @4,000 ft away.

He needs more information on the treatment well to determine if a permit is needed. They exempt monitoring wells, and could possibly exempt treatment wells.

[C. Jones called back on Friday. An additional well closer to the site than 1.2 is located at 5316 Godwin Blvd. It is a shallow well (30-40 ft deep), located approximately 7,000 ft from the site. It was constructed in 1983.]

His review is based on records from 1982 to present. In 1982, if new home construction included both a septic tank and well, a permit was required. As of September 1990, all new wells and replaced existing wells have to be permitted.

oio/ZD3081
[ENV]D1488

G. ROBERT HOUSE WATER TREATMENT FACILITY

P.O. Box 2368 SUFFOLK, VIRGINIA 23432 PHONE (804) 255-2[illegible]

PUBLIC UTILITIES
WATER PRODUCTION DIVISION

Ms. Mary L. McHugh
Project Hydrogeologist
Ecology and Environment, Incorporated
368 Pleasantview Drive
Lancaster, New York 14086

Re: City of Suffolk, Virginia: Pembroke Production Wells

April 19, 1991

Dear Ms. McHugh:

The copies you sent me of well logs, well completion records and sketches for Pembroke Well P-1 and observation wells 0-1 and 0-2 appears, according to my records, to be correct. This is also the case with the well log for Pembroke Well P-2. I am enclosing an additional well log and registration statement for Pembroke Well P-2 which should supply the additional information you requested.

In regards to testing of P-1 and P-2, there has never to my knowledge been any testing done on these wells for pentachlorophenol or any other compounds as they are used so infrequently. The lake into which these wells feed is tested weekly, however pentachlorophenol is not one of the parameters.

The City of Suffolk has three major sources for raw water. Crump's Mill Pond surface water is treated by conventional methods (coagulation, flocculation, sedimentation and filtration) at the G. Robert House Water Treatment Facility. Lone Star Lakes is our second surface water source which is also treated by conventional methods at the same treatment plant. We primarily use Crump's Mill Pond as our surface source during the summer while during the winter months we operate from Lone Star Lakes. During the time period we are on Lone Star we simultaneously pump Crump's Mill Pond directly into Lone Star in order to increase Lone Star's overall storage capacity. We obtain approximately 50% of our finished water requirements from these two sources.

Our third source of raw water is a 915 foot deep well which is treated by electrodialysis reversal (EDR) desalination technology. The EDR units are also located at the same water treatment

facility as the conventional plant. This system accounts for the other 50% of our finished water demand.

I hope this information will help you with your report. If you need any additional information or if I can answer any questions you might have please feel free to contact me at your convenience.

I'm looking forward to meeting you and showing you our facilities if by chance your work should bring you back to this area.

Sincerely,

Thomas E. Werner

Water Production Manager

FORM GW-4
10/74 300

COMMONWEALTH OF VIRGINIA
STATE WATER CONTROL BOARD
P. O. Box 11143, 2111 North Hamilton Street
Richmond, Virginia 23230
Phone (804) 786-1411

REGISTRATION STATEMENT

(For Use in Critical Groundwater Areas)

OWNER'S WELL NO.: 103.1.2.4
SWCB REGISTRATION NO.:
DATE RECEIVED: 12/24/86

RECEIVED NRO Tidewater Regional Office

SECTION 1
GENERAL:

This REGISTRATION STATEMENT, pursuant to Section 62.1-44.99, Chapter 3.4, Title 62.1, is filed with the State Water Control Board as evidence that the person named hereon, as owner, does hereby claim the right to use groundwater as described and sworn to (One Registration Statement shall be completed and filed for each water well owned by the person named hereon.)

OWNER: City of Suffolk
ADDRESS: Post Office Box 1858
Suffolk, VA 23434

PHONE: (804) 934-3111, Ext. 292

SECTION 3
WELL CONSTRUCTION DATA:

1. Total depth of water well 125 feet (If drawing of well to be or as constructed and installed is available, furnish such drawing herewith and omit data requested in this section).

2. Water well contractor who constructed or is constructing the above well:

NAME: Layne Atlantic Company
ADDRESS: 3322 Cromwell
Norfolk, VA 23509

3. DATE COMPLETED: 3/84
or day/mo./yr.
DATE OF EXPECTED COMPLETION: _____ day/mo./yr.

4.

HOLE SIZE:	CASING SIZE
12 in. from 0 to 125 ft.	6 in. from 12 to 64 ft.
___ in. from ___ to ___ ft.	6 in. from 84 to 87 ft.
___ in. from ___ to ___ ft.	6 in. from 97 to 102 ft.
___ in. from ___ to ___ ft.	___ in. from ___ to ___ ft.
WATER ZONES:	**SCREENS:**
from ___ to ___ ft.	6 in. from 64 to 84 ft.
from ___ to ___ ft.	6 in. from 87 to 97 ft.
from / to ___ ft.	___ in. from ___ to ___ ft.

SECTION 2
GROUNDWATER USE:

The following section will be used as a guide for determining owner's rights to apply groundwater to a beneficial use under Section 62.1-44.93

Instructions:

1. State maximum pumpage figure for the above well. Maximum pumpage means the maximum pumpage on any given day within two (2) years prior to the date of declaration of the critical groundwater area.
Maximum pumpage from this single well = 185,700 gallons per day on 17/7/85 date. day/mo./yr.

2. State maximum pumpage figure for entire well system*
Maximum pumpage from well system = 462,100 gallons per day on 17/7/85 date. day/mo./yr.

*Note:
A REGISTRATION STATEMENT must be filed for each well within a well system. Instruction No. 1 will indicate pumpage for one well. Instruction No. 2 will indicate total system pumpage for all wells and will remain the same and be repeated on each REGISTRATION STATEMENT.

Water well located in Suffolk city/~~county~~ in Southeastern critical groundwater area, approximately 1.28 ~~feet~~/miles E (direction) of Rt. 10 and 60 ~~feet~~/~~miles~~ N (direction) of Pembroke.

Was well in operation prior to declaration of critical groundwater area? Yes or (No) (circle)

Was well under construction at the time of declaration of critical groundwater area? Yes or (No) (circle)

NORFOLK, VA.

LOG OF WELL For City of Suffolk

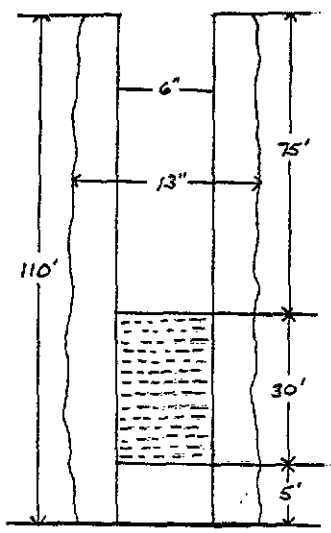
Located at Pembroke Road No. 2 in Chuckatuck County, State Virginia

Date Drilling Started 1/23/84 19 Date Started 12/28/83 19

Finished Drilling 3/9/84 19 Finished 4/23/84 19

FORMATIONS AND DEPTH OF WELL

TOTAL DEPTH OF ALL STRATA FT.	TOTAL DEPTH OF ALL STRATA IN.	DEPTH OF EACH STRATUM FT.	DEPTH OF EACH STRATUM IN.	FORMATION FOUND AT EACH STRATUM
8		8		brown & yellow clay, hard
16		8		grey & white sand
18		2		yellow clay
40		22		white & grey sand
42		2		yellow clay, hard
52		10		grey sand, traces of shells
62		10		med. grey sand, some blue clay, more shells than above
72		10		med. to coarse sand, some clay, more shells than above
82		10		med to coarse sand & shells, some blue clay
92		10		fine sand & shells, blue clay
102		10		fine silty sand & some shells, traces of blue clay
127		25		fine silty black pepper sand & traces of shells



DIMENSIONS OF CASING AND SCREEN

TOTAL LENGTH OF ALL SCREENS and CASINGS FT.	TOTAL LENGTH OF ALL SCREENS and CASINGS IN.	LENGTH OF EACH SEC. OF SCREEN OR CASING FT.	LENGTH OF EACH SEC. OF SCREEN OR CASING IN.	SPECIFY SCREEN OR CASING	SIZE OF SCREEN OR CASING IN.	GAUGE OF SCREEN
75		75		casing	6	
30		30		screen	6	.012
80		5		casing	6	

WELL DATA:

Preliminary Test

Date Tested 19 Static Level

Production GPM Pumping Level

Permanent Test

Date Tested 19 Static Level

Production GPM Active St. Level

Drawdown Pumping Level

Remarks:

PUMP DATA:

Shop No. Type Lubr.

Type Head Size Suction

Depth Setting (BP to MB)

Size Column Length Suction

Type Bowl Length Air Line

No. Stages Discharge-

Cap'y and Head Pressure

MOTOR DATA:

Horsepower Voltage

RPM Phase

Type Cycles

Make Frame No.

CONTACT REPORT

Telephone (X) Meeting ( ) Other ( )

AGENCY: City of Suffolk, Department of Public Utilities

ADDRESS: G. Robert House Treatment Plant

PHONE NO.: (804) 255-2247

PERSON CONTACTED: Tom Werner, Water Production Manager

TO: Fred McKosky

FROM: M. McHugh

DATE: February 6, 1991

SUBJECT: Water Supply System

CC: CTF ZD3081

Spoke with Tom Werner requesting information about the Pembroke wells located approximately 1/4 mile south of the site. Tom said the wells were part of the City of Suffolk reserve system and were operated only when supplemental water was needed. During the past year (1990) only of these wells (Pembroke 1) was only operated during a limited period as summarized below. Tom felt that the 1990 usage was consistent with previous usage in other years. Generally the well(s) is run continuously for a day or two each month and the water allowed to run along an open unlined canal to Lone Star Lake. Tom said this in effect provides the farmers in the area with irrigation water, although that is not the intent. During 1990 the greatest water volume discharged from Pembroke well 1 in a single month was pumped in a single day (July 210,000 gallons). Volumes given below are in gallons at the well head.

Tom did not have depth data on the wells but knows they are relatively shallow. The wells are not sampled by the City of Suffolk; however, the water at the intake at Lone Star Lake is sampled. The contribution of the water from the Pembroke wells to the water at the intake at Lone Star Lake is likely to be minor compared to the water derived from the lake itself.

In an earlier conversation with Shahram Mohsenin (804-363-3876) of the Virginia Department of Health (January 31, 1991), stated that the Virginia Department of Health does not sample the water from the Pembroke wells.

Month	Water in Gallons Pumped from Pembroke
January	0
February	0
March	0
April	0
May	150,000
June	20,000
July	210,000
August	120,000
September	40,000
October	100,000
November	0
December	0

MM/mm/wf
CR/ZD3081

CC: M. McHugh

CONTACT REPORT

Meeting [ ] Telephone [X] Other [ ]

AGENCY: City of Suffolk, Department of Public Utilities

ADDRESS: G. Robert House Treatment Plant

PHONE NO.: (804) 255-2247

PERSON CONTACTED: Tom Werner, Water Production Manager

TO: Fred McKosky

FROM: Matthew Durnin

DATE: February 1, 1991

SUBJECT: Water Supply System

CC: CTF ZD-3081

Contact was made with the City of Suffolk, Department of Public Works in order to talk with Ms. Eva Tillete the water treatment specialist. Unfortunately, Ms. Tillete no longer works there. However, I was able to speak with a Mr. Tom Werner in regards to the information we need.

After I introduced myself and told Mr. Werner what we needed he informed me that Wesley Lane Well had been shut down 10 months ago, and Crumps Mill Well had been shut down 6 months ago. Since the previous contact was made leaks were discovered in both wells, and they were subsequently shut down. Since the well shut downs everyone previously serviced by these wells has been switched over to city water. City water comes from the Lone State Lakes. Sometimes water from Crump Mill Pond is used after it is treated with electrodialisis reversal.

I explained to Mr. Werner why we need the original information and he was very helpful. He said he would send his yearly Water Quality Report for 1990 which gives the most recent information on water usage. This report will incorporate the same information we obtained from Ms. Tillete on usage and water quality in the area. Mr. Werner also said he would send a map highlighting the areas serviced by the public water system both prior to and after the wells were shut down.

If the need still exists, although it seems irrelevant now, Mr. Werner said to send the lists of people serviced by the wells which was supplied by Ms. Tillete and he would verify that this information was correct for the time in question.

Mr. Werner said that Linda Shaw (Quality Control Coordinator) would be handling most of this work request for us. I asked Mr. Werner if he could get this information to us as soon as possible. He said it probably would be sometime next week before we get it.

G. ROBERT HOUSE WATER TREATMENT FACILITY

P.O. Box 2368 SUFFOLK, VIRGINIA 23432 PHONE (804) 255-2247

PUBLIC UTILITIES
WATER PRODUCTION DIVISION

Recd 2/11/91 FSmyk

February 5, 1991

Mr. Matthew Durnin
Ecology and Environment, Inc.
368 Pleasantview Drive
Lancaster, New York 14086

Dear Mr. Durnin:

Enclosed you will find the information you requested on the Wesley Lane Well and the Crumps Mill Well.

The information you have on the service connections is correct, with no additional connections.

If you require any other information please feel free to contact me at the address or phone number listed on the letterhead.

Refer to City of Suffolk memo of 9/12/88

Sincerely,

Lynda F. Shaw

Lynda F. Shaw
Quality Control

VIRGINIA STATE WATER CONTROL BOARD
ANNUAL REPORT of WATER WITHDRAWALS
For the period: January 1, 1990 to December 31, 1990

OWNER: SUFFOLK, CITY OF
SYSTEM: SUFFOLK

********** RAW WATER WITHDRAWALS **********

Water Withdrawal Amount in Million Gallons (MG)

SOURCE: CEDAR POINT WELL #1

VWUDS I.D.: 0428-WL-365400076291501
WELL I.D.: 161-112
PERMIT #: 003800100 AGENCY: VDH
INTAKE LOCATION: CITY OF SUFFOLK
LATITUDE: 365400 LONGITUDE: 0762915
MEASURING METHOD:
Metering (Source) X (Customer) ____
Pump Curves and Time ____
Other (Describe) ____
MAXIMUM DAY: 0.00 MG MONTH occurred: n/a

January:	0.0	MG
February:	0.0	MG
March:	0.0	MG
April:	0.0	MG
May:	0.0	MG
June:	0.0	MG
July:	0.0	MG
August:	0.0	MG
September:	0.0	MG
October:	0.0	MG
November:	0.0	MG
December:	0.0	MG

COMMENTS: ____

SOURCE: CRUMPS MILL WELL #1-CHUCKATUCK

VWUDS I.D.: 0428-WL-365147076345801
WELL I.D.: 161-175
PERMIT #: 003800120 AGENCY: VDH
INTAKE LOCATION: CITY OF SUFFOLK
LATITUDE: 365147 LONGITUDE: 0764358
MEASURING METHOD:
Metering (Source) X (Customer) ____
Pump Curves and Time ____
Other (Describe) ____
MAXIMUM DAY: 0.143MG MONTH occurred: June

January:	0.51	MG
February:	1.80	MG
March:	1.87	MG
April:	1.96	MG
May:	1.90	MG
June:	2.00	MG
July:	0.48	MG
August:	0.05	MG
September:	0.0	MG
October:	0.0	MG
November:	0.0	MG
December:	0.0	MG

COMMENTS: Well no longer in use however still operational

SOURCE: KINGS POINT WELL #1

VWUDS I.D.: 0428-WL-364650076371601
WELL I.D.: 161-
PERMIT #: 003800375 AGENCY: VDH
INTAKE LOCATION: CITY OF SUFFOLK
LATITUDE: 364650 LONGITUDE: 0763716
MEASURING METHOD:
Metering (Source) X (Customer) ____
Pump Curves and Time ____
Other (Describe) ____
MAXIMUM DAY: 0.019 MG MONTH occurred: January

January:	0.19	MG
February:	0.10	MG
March:	0.09	MG
April:	0.11	MG
May:	0.09	MG
June:	0.13	MG
July:	0.11	MG
August:	0.11	MG
September:	0.08	MG
October:	0.12	MG
November:	0.10	MG
December:	0.10	MG

COMMENTS: ____

VIRGINIA STATE WATER CONTROL BOARD
ANNUAL REPORT of WATER WITHDRAWALS
For the period: January 1, 1990 to December 31, 1990

OWNER: SUFFOLK, CITY OF
SYSTEM: SUFFOLK

********** RAW WATER WITHDRAWALS **********

SOURCE: WESLEY LANE WELL #2-CHUCKATUCK
VWUDS I.D.: 0428-WL-363935076380001
WELL I.D.: 161-176
PERMIT #: 003800120 AGENCY: VDH
INTAKE LOCATION: CITY OF SUFFOLK
LATITUDE: 365148 LONGITUDE: 0763458
MEASURING METHOD:
Metering (Source) X (Customer) ____
Pump Curves and Time ____
Other (Describe) ____
MAXIMUM DAY: 0.004 MG MONTH occurred: January

Water Withdrawal Amount in Million Gallons (MG)

January:	0.09	MG
February:	0.02	MG
March:	0.00	MG
April:	0.00	MG
May:	0.00	MG
June:	0.00	MG
July:	0.00	MG
August:	0.00	MG
September:	0.00	MG
October:	0.00	MG
November:	0.00	MG
December:	0.00	MG

COMMENTS: Well no longer in use however still operational.

SOURCE: CITY FARM WELL #2
VWUDS I.D.: 0672-WL-364507076350301
WELL I.D.: 161-330
PERMIT #: 003800805 AGENCY: VDH
INTAKE LOCATION: CITY OF SUFFOLK
LATITUDE: 364503 LONGITUDE: 0763505
MEASURING METHOD:
Metering (Source) X (Customer) ____
Pump Curves and Time ____
Other (Describe) ____
MAXIMUM DAY: 0.261 MG MONTH occurred: May

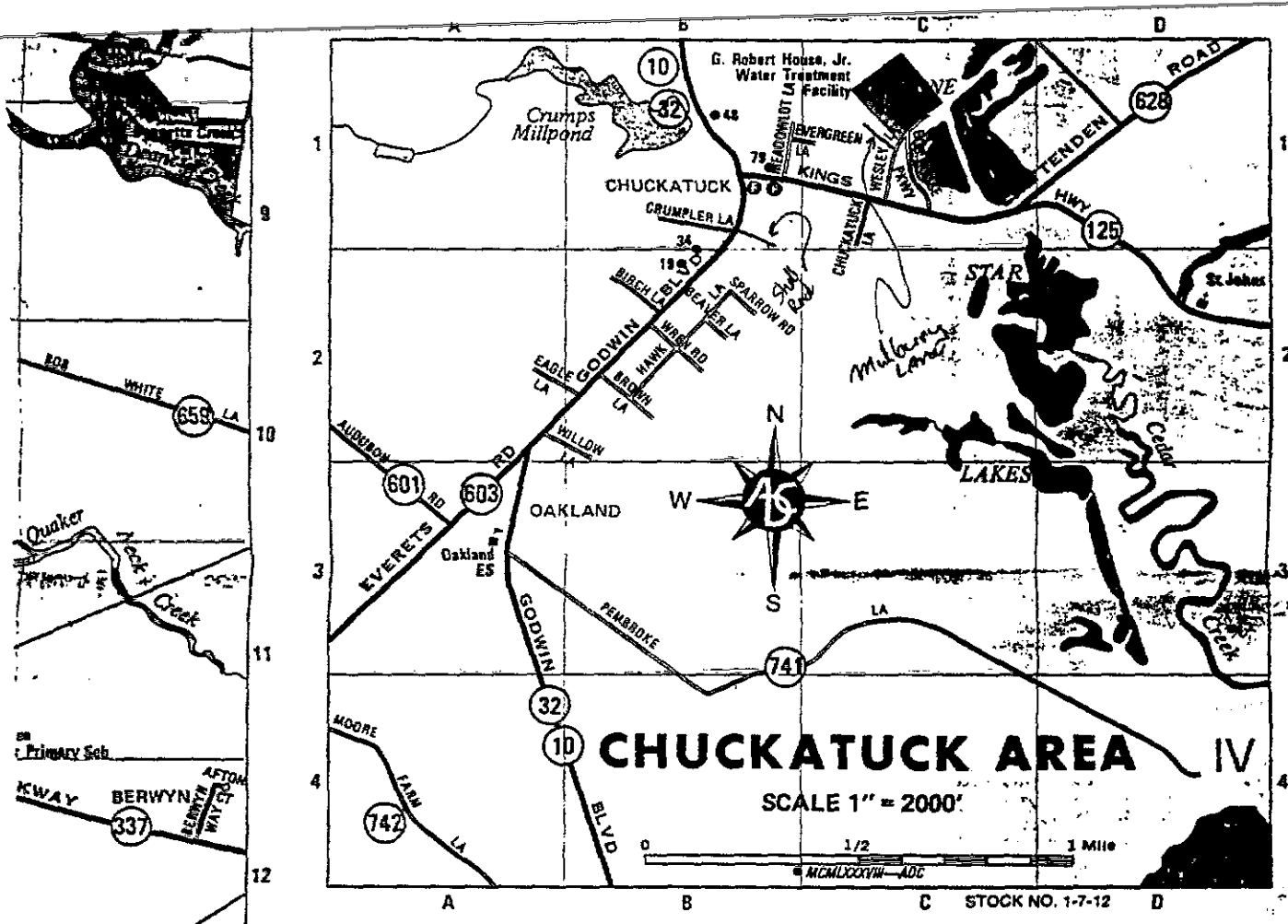
January:	0.05	MG
February:	0.09	MG
March:	0.08	MG
April:	0.06	MG
May:	0.26	MG
June:	0.05	MG
July:	0.03	MG
August:	0.04	MG
September:	0.06	MG
October:	0.12	MG
November:	0.07	MG
December:	0.04	MG

COMMENTS: ____

SOURCE: PLANT WELL #1 (FLOURIDE)
VWUDS I.D.: 0672-WL-365151076343301
WELL I.D.: 161-380
PERMIT #: 003800805 AGENCY: VDH
INTAKE LOCATION: CITY OF SUFFOLK
LATITUDE: 365151 LONGITUDE: 0763433
MEASURING METHOD:
Metering (Source) X (Customer) ____
Pump Curves and Time ____
Other (Describe) ____
MAXIMUM DAY: 0.997 MG MONTH occurred: April

January:	26.5	MG
February:	23.7	MG
March:	27.1	MG
April:	26.7	MG
May:	26.7	MG
June:	25.8	MG
July:	16.2	MG
August:	6.86	MG
September:	9.09	MG
October:	5.03	MG
November:	2.52	MG
December:	2.22	MG

COMMENTS: ____



Health & Fitness Program Consultants

58. Southeastern Wellness Institute — 804-539-7134 — I H4
1138/40 Myrtle St.
The Fitness Professionals

Heating Contractors - See A/C & Heating Contr #3 or 4

Hill Point Farms

58 Oceans Holding Inc — 804-473-3456 — VI T6
412 Investors Place Suite 103
VA Beach, VA. 23452
Developers of: Hill Point Farms

Home Improvements

60. Home Improvement Co of VA. — 804-539-8602 — VI S10
1269 Carolina Rd
Awnings - Carports - Siding & Storm Windows & Doors

Hospitals

61. Lucas Obici Memorial Hospital — 804-934-4000 — I P2
1900 North Main St.

62. Maryview Medical Center — 804-398-2200 — VI Z3
3636 High St. (US17)
Portsmouth, VA 23707
Providing Quality Health Care to: Suffolk/Ports./Chesapeake

Insurance

63. Holland-Johnson & Associates — 804-539-7721 / 804-485-2520 — I E1
3453 Pruden Blvd.
Curtis M Holland & Robert L. Johnson Jr., CLU., CHFC
Health - Life & Group - Financial Services

64. J. Walter Hosier & Son Inc. — 804-539-0288 — I E5&6
521 W. Wash. St.
Karl B. Spain C.I.C
Business & Personal Insurance

65. Suffolk Insurance Corp — 804-539-9988 — I F5
Downtown
292 Market St. P.O. Box 1280

65A. 3987 Bridge Rd. Suite "B" — 804-484-8862 — V F7
North Suffolk
P.O. Box 5088 Suffolk VA 23435
Life - Auto - Fire - Casualty - Marine-Health & Bond

Loans

66 Transouth Financial Services — 804-539-3471 — I F4
196 W. Constance Rd.
Personal, Home Equity & Major Purchases Loans
Apply-By-Phone Services

Loans - Savings & Loan

67 Investors Savings Bank — 804-399-3081 / 804-236-3141 — V F2
North Suffolk Location
3837 Eclipse Drive
Suffolk, VA 23433

67A. Downtown Location
117 Market St.

Manufacturing

68. Planters & Life Saver
300 Johnson Ave

Mariners & Boat Repairs

69. Brady's Marina — 804-539-822
3484 Godwin Blvd.

Mobile Homes - Dealer

70. East Coast Sales Inc. — 804-934-080 / 804-934-036
Hwy 58 West
Single & Double Wides & Modulars
Financing Available

Motels

71. Scene Lodge — 804-539-346
1017 N. Main St (U.S. Hwy 460)
Commercial Rates - Free Local Calls - Handycap Rooms - Free Morning Coffee - Major Credit Cards Accepted

72. Holiday Inn — 804-934-231
3864 Pruden Blvd.
RT-460 W & RT-58 By Pass
Banquet Facilities - Restaurant & Lounge

News Papers

73. The Daily Press, Inc. — 804-247-491
7508 Warwick Blvd., P.O. Box 746
Newport News, VA. 23607

Suffolk Office
908 Suffolk Plaza Shopping Center — 804-539-309

Nurses -See Health Care #67

Nursing Homes

74. Autumn Care of Suffolk — 804-934-236
3589 Pruden Blvd.
A Growing Tradition in Health Care Excellence

83A. Maryview Nursing Care Center — 804-398-320
4800 Black Bridge Rd.
Suffolk, VA. 23435

Office Supplies & Equipment

75. Buck Office Supply — 804-539-020
412 N. Main St
Supplies - Furniture - Equipment
Established 1947

Outboard Motors

76. Service Center Unlimited — 804-934-380
1440 Holland Rd
Electric Trolling Motor Parts & Repairs

LAB #: 0 0 4 6 8 DEC 19 88

Water Quality Report

RADIOLOGICAL

WSE 50

Commonwealth of Virginia
Department of Health
Division of Water Programs
Bureau of Water Supply Engineering

NAME OF WATER SYSTEM: CHUCKATUCK
SOURCE: CHUCKATUCK WELL (DEEP WELL)
OTHER INFORMATION: SUFFOLK WATER TREATMENT PLANT
P.O. BOX 2368
SUFFOLK, VIRGINIA 23432

REPORT RESULTS TO HEALTH OFFICIAL AT:
Name: VA. STATE HEALTH DEPT.
Address: 5700 THURSTON AVE. SUITE 203
City: VA. BEACH Zip Code: 23455

REGION: ☐ Abingdon ☐ Danville ☐ Richmond ☐ Local Health Dept.
☐ Culpeper ☐ Lexington ☒ Tidewater ☐

PLANNING DISTRICT # 20
COUNTY:
INDEPENDENT CITY: SUFFOLK

SAMPLING LOCATION: CHUCKATUCK WELL HOUSE
CODE:

SOURCE TYPE:
☒ Public Community
☐ Public Noncommunity

FIELD TESTS: Temp: 18°C pH: 8.33
Cl2: mg/L Alk: mg/L CO2 mg/L Hard: mg/L

P.W.S.I.D. #: 3 8 0 0 1 2 0
TRANSACTION CODE: 0 3

DATE COLLECTED: Mo 12 Day 14 Yr 88
TIME: 1217
COLLECTED BY: T. WERNER

CONTAINER TYPE:
☐ Glass
☒ Plastic

PRESERVATIVE USED:
☒ None
☐ Ice
☐ Other
☐ Nitric Acid

SAMPLE TYPE:
D ☒ Reg. Dist.
P ☐ Plant Tap
R ☐ Raw Water
C ☐ Check
M ☐ MCL Check
S ☐ Other

CONT. I.D.	CONTAMINANT NAME (Maximum Allowable Level)	MTD.	S	ANALYSIS RESULTS	PRECISION	ANALYSIS DATE Mo Day Yr	A*
4000	Gross Alpha 15 pCi/L	419		ØØ Ø8 ØØ	± Ø 1 5	12 20 88	JC
4010	Combined Radium 5pCi/L	420		ØØ ØØ ØØ	± Ø		
4020	Radium 226	421		ØØ ØØ ØØ	± Ø		
4030	Radium 228	422		ØØ ØØ ØØ	± Ø		
4100	Gross Beta 50 pCi/L	419		ØØ 55 ØØ	± Ø 1 4	12 20 88	JC
4006	Uranium			ØØ ØØ ØØ	± Ø		
4012	Tritium						

LAB I.D. 0 0 0 9 5

RECEIVED
JAN 25 1989
VDH
OFFICE

DATE REC: DEC 16 1988
DATE REP: DEC 21 1988

PREPARED BY: T. Werner

The results on this report are expressed in pCi/L unless otherwise indicated *A = analyst's initials

recycled paper

C-29

AR301651

LAB #: G 0 3 5 5 0 (1-6)

NAME OF WATER SYSTEM: CHUCKA TRUCK

SOURCE: GROUND WATER

OTHER INFORMATION: SMALL SYSTEM

REPORT RESULTS TO HEALTH OFFICIAL AT:
Name
Address
City ZipCode

Water Quality Report

METALS

WSE 50

Commonwealth of Virginia
Department of Health
Division of Water Programs
Bureau of Water Supply Engineering

REGION: ☐ Abingdon ☐ Danville ☐ Richmond ☐ Local Health Dept
☐ Culpeper ☐ Lexington ☑ Virginia Beach ☐

PLANNING DISTRICT #: 20

SAMPLING LOCATION: WELL HOUSE

SOURCE TYPE: ☑ Public-Community ☐ Public-Noncommunity

COUNTY:

INDEPENDENT CITY: SUFFOLK

CODE: 1 20 00 (7-9)

FIELD TESTS: Temp: 20 Cl_2: mg/L CO_2 mg/L
pH: 7.8 Alk: 500 mg/L Hard.: 1 mg/L

P.W.S.I.D. #: 3 8 0 0 1 2 0 (10-16)

TRANSACTION CODE: 0 3 (17-18)

DATE COLLECTED: Mo 0 6 Day 0 1 Yr 8 4 (19-24)

TIME: 1 2 1 0 (25-28)

COLLECTED BY: WT

CONTAINER TYPE:
☐ Glass
☒ Plastic

PRESERVATIVE USED:
☐ None
☐ Ice
☐ Other
☒ Nitric Acid

SAMPLE TYPE:
D ☒ Reg. Dist.
P ☐ Plant Tap
R ☐ Raw Water
C ☐ Check
M ☐ MCL Check
☐ Other
(29)

DATE REC: JUN 05 1984
DATE REP: AUG 31 1984

CONT. I.D. (30-33)	CONTAMINANT NAME (Maximum Allowable Level)	MTD. (39-41)	S	ANALYSIS RESULTS (43-50)	PRECISION (51-53)	ANALYSIS DATE Mo Day Yr (54-59)	A*
1005	Arsenic 0.05	125		0.0038	±	06 19 84	AHS
1010	Barium 1.0	128	<	0.010	±	06 06 84	AHS
1015	Cadmium 0.010	125		0.0006	±	06 19 84	AHS
1020	Chromium 0.05	125	<	0.005	±	06 19 84	AHS
1030	Lead 0.05	125		0.009	±	06 19 84	AHS
1035	Mercury 0.002	106		0.0004	±	06 07 84	AHS
1045	Selenium 0.01	125	<	0.001	±	06 19 84	AHS
1050	Silver 0.05	125	<	0.005	±	06 19 84	AHS
1002	Aluminum	108	<	0.01	±	06 06 84	AHS
1006	Calcium	108		69	±		
1028	Iron 0.30	108	<	0.01	±		
1031	Magnesium	108		2.4	±		
1032	Manganese 0.05	108		0.03	±		
1051	Strontium	108		0.01	±		
1095	Zinc 5.0	108		0.014	±		
1022	Copper 1.0	108	<	0.001	±		
1019	Potassium	108		4.63	±		
1052	Sodium 20.	108		19.4	±		
1036	Nickel	108	<	0.001	±		
1001	Boron	108		0.13	±		
1918	Calcium Hardness			174	±		
1918	Magnesium Hardness			9	±		
1913	Ca & Mg Hardness			3	±		
1915	Total Hardness ***			3	±		
					±		
					±		
	*** (Al, Ca, Fe, Mg, Mn, Sr, & Zn)				±		

LAB I.D. 0 1 0 0 0 (34-38)

PREPARED BY: Robert D. Patton

The results on this report are expressed in mg/L unless otherwise indicated. *A = analyst's initials

C-30

AR301652

LAB #: G 0 3 5 4 9 (1-6)

NAME OF WATER SYSTEM: CHuck ATack

SOURCE: GROUND WATER

OTHER INFORMATION: SMALL SYSTEM

REPORT RESULTS TO HEALTH OFFICIAL AT: Name / Address / City / Zip Code

Water Quality Report

INORGANIC

WSE 50

Commonwealth of Virginia
Department of Health
Division of Water Programs
Bureau of Water Supply Engineering

REGION: ☐ Abingdon ☐ Culpeper ☐ Danville ☐ Lexington ☐ Richmond ☑ Virginia Beach ☐ Local Health Dept.

PLANNING DISTRICT # 20

SAMPLING LOCATION: well house

SOURCE TYPE: ☑ Public-Community ☐ Public-Noncommunity

COUNTY:

INDEPENDENT CITY: SUFFOLK

CODE: 1 0 0 (7-9)

FIELD TESTS: Temp: 20 pH: 7.8 Cl_2: mg/L Alk: 500 mg/L CO_2 mg/L Hard.: 1 mg/L

P.W.S.I.D. #: 3 8 0 0 1 2 0 (10-16)

TRANSACTION CODE: 0 3 (17-18)

DATE COLLECTED: Mo 0 6 Day 0 1 Yr 8 4 (19-24)

TIME: 1 2 1 0 (25-28)

COLLECTED BY: WT

CONTAINER TYPE: ☐ Glass ☑ Plastic

PRESERVATIVE USED: ☑ None ☐ Ice ☐ Other ☐ Nitric Acid

SAMPLE TYPE: D ☑ Reg. Dist. P ☐ Plant Tap R ☐ Raw Water C ☐ Check M ☐ MCL Check ☐ Other (29)

CONT. I.D.	CONTAMINANT NAME (Maximum Allowable Level)	MTD.	S	ANALYSIS RESULTS	PRECISION	ANALYSIS DATE Mo Day Yr	A*
1925	pH (6.5-8.5)	135		ø ø ø 8 5 3 ø ø	±	ø 6 ø 7 8 4	JAC
1927	Alkalinity-Total	155		ø 3 3 4 2 ø ø ø	±	ø 6 ø 7 8 4	JAC
1928	Alkalinity-Bicarbonate	155		ø 3 2 1 4 ø ø ø	±	ø 6 ø 7 8 4	JAC
1929	Alkalinity-Carbonate	155		ø ø 1 2 8 ø ø ø	±	ø 6 ø 7 8 4	JAC
1905	Hardness-EDTA	141		ø ø ø 3 ø ø ø ø	±	ø 6 ø 6 8 4	FTS
1932	Acidity	157		ø	±		
1910	Corrosion Index	136		ø ø 1 ø 5 5 ø ø	±	ø 6 1 9 8 4	KML
1056	Fluoride 1.8	107		ø ø ø 5 1 9 ø ø	±	ø 6 ø 6 8 4	JAC
1017	Chloride 250	160		ø ø ø 4 3 7 ø ø	±	ø 6 ø 6 8 4	JAC
1924	Color (APHA) 15 CU	024	<	ø ø ø 5 ø ø ø ø	±	ø 6 1 3 8 4	ALS
1926	Turbidity (FTU) 1.0	038		ø ø ø ø 8 ø ø ø	±	ø 6 1 5 8 4	KML
1007	Hydrogen Sulfide 0.05	155	<	ø ø ø ø ø 1 ø ø	±	ø 6 1 3 8 4	ALS
1945	Sulfate 250	137		ø ø ø 1 ø ø ø ø	±	ø 6 1 4 8 4	KML
1046	Nitrogen Nitrate 10.0	113		ø ø ø ø ø 5 ø ø	±	ø 6 ø 6 8 4	DWO
1039	Nitrogen-Ammonia	137		ø ø ø ø 2 ø ø ø	±		DWO
1038	Nitrogen-Nitrite	103	<	ø ø ø ø ø 1 ø ø	±		DWO
1041	Nitrogen-Total Kjeldahl	155		ø ø ø ø 2 ø ø ø	±		SAH
1043	Phosphate Total (As P)	102		ø ø ø ø 5 ø ø ø	±		SAH
1044	Phosphate Ortho (As P)	162		ø ø ø ø 5 4 ø ø	±		DWO
1926	Specific Conductance (umhos/cm)	145		ø 6 3 2 8 ø ø ø	±	ø 6 ø 8 8 4	JAC
1930	Total Dissolved Solids (185°C) 0.63	139		ø 4 ø ø ø ø ø ø	±	ø 6 1 9 8 4	RW
1058	Volatile (550°C)	139		ø 1 4 4 ø ø ø ø	±		
1059	Fixed (550°C)	139		ø 2 5 6 ø ø ø ø	±		
1049	Silica (as SiO_2)	143		ø ø 1 6 ø 8 ø ø	±	ø 6 ø 5 8 4	AKS
	Langlier @ 20° C		-	ø ø ø 1 3 9 3 ø	±	ø 6 1 9 8 4	KML
					±		
					±		

(30-33) LAB I.D. 0 1 0 0 0 (34-38) (39-41) (43-50) (51-53) (54-59)

DATE REC: JUN 05 1984

DATE REP: AUG 31 1984

PREPARED BY: Robert D. Patton

The results on this report are expressed in mg/L unless otherwise indicated. *A = analyst's initials

C-31

recycled paper

ecology and environment

AR301653

9 6 8 5 6 0 DEC 29 89

LAB #: (1-6)

Water Quality Report

RADIOLOGICAL

WSE 50

Commonwealth of Virginia
Department of Health
Division of Water Programs
Bureau of Water Supply Engineering

NAME OF WATER SYSTEM: CHUCKATUCK WELL SYSTEM
SOURCE: DEEP WELL
OTHER INFORMATION: CITY OF SUFFOLK
P.O. BOX 2368
SUFFOLK, VIRGINIA 23432

REPORT RESULTS TO HEALTH OFFICIAL AT:
Name: VIRGINIA STATE HEALTH DEPT.
Address: 5700 THARSTON AVE, SUITE 203
City: VIRGINIA BEACH Zip Code: 23455

REGION: ☐ Abingdon ☐ Danville ☐ Richmond ☐ Local Health Dept.
☐ Culpeper ☐ Lexington ☒ Virginia Beach ☐

PLANNING DISTRICT #: 20
SAMPLING LOCATION: WELL HOUSE
COUNTY:
CODE: (7-9) (WESLEY LANE)
INDEPENDENT CITY: SUFFOLK

SOURCE TYPE:
☒ Public-Community
☐ Public-Noncommunity

FIELD TESTS: Temp: 13°C Cl2: mg/L CO2 mg/L
pH: 8.21 Alk: mg/L Hard.: mg/L

P.W.S.I.D. #: 3 8 0 0 1 2 0 (10-16)
TRANSACTION CODE: 0 3 (17-18)

DATE COLLECTED: Mo 12 Day 27 Yr 89 (19-24)
TIME: 1320 (25-28)
COLLECTED BY: T. WERNER
CONTAINER TYPE: ☐ Glass ☒ Plastic
PRESERVATIVE USED: ☒ None ☐ Ice ☐ Other ☐ Nitric Acid
SAMPLE TYPE: D ☒ Reg. Dist. P ☐ Plant Tap R ☐ Raw Water C ☐ Check M ☐ MCL Check S ☐ Other (29)

CONT. I.D.	CONTAMINANT NAME (Maximum Allowable Level)	MTD.	S	ANALYSIS RESULTS	PRECISION	ANALYSIS DATE Mo Day Yr	A*
4000	Gross Alpha 15 pCi/L	419		∅∅ 19 ∅∅	± ∅ 13	1 4 90	SAD
4010	Combined Radium 5pCi/L	420		∅∅ ∅∅	± ∅		
4020	Radium-226	421		∅∅ ∅∅	± ∅		
4030	Radium-228	422		∅∅ ∅∅	± ∅		
4100	Gross Beta 50 pCi/L	419		∅∅ 46 ∅∅	± ∅ 14	1 4 90	SAD
4006	Uranium			∅∅ ∅∅	± ∅		
4102	Tritium				±		

LAB I.D. 0 0 0 9 5 (34-38)

(30-33) (39-41) (42) (43-50) (51-53) (54-59)

DATE REC'D DEC 29 1989
DATE REP: JAN 04 1990

PREPARED BY: S Dugas KLS

The results on this report are expressed in pCi/L unless otherwise indicated. *A = analyst's initials

C-32

AR301654

New Well - Quarterly Sample (3rd Quarter)

LAB #: 9 5 P 4 3 1 2 SEP 26 89

NAME OF WATER SYSTEM: CHUCKATUCK WELL SYSTEM

SOURCE: DEEP WELL (WESLEY LANE WELL)

OTHER INFORMATION: CITY OF SUFFOLK, P.O. BOX 2368, SUFFOLK, VA 23432

REPORT RESULTS TO HEALTH OFFICIAL AT:
Name: VA. STATE HEALTH DEPT.
Address: 5700 THURSTON AVE, SUITE 203
City: VA. BEACH Zip Code: 23455

Water Quality Report

RADIOLOGICAL

WSE 50

Commonwealth of Virginia
Department of Health
Division of Water Programs
Bureau of Water Supply Engineering

REGION: ☐ Abingdon ☐ Culpeper ☐ Danville ☐ Lexington ☐ Richmond ☒ Virginia Beach ☐ Local Health Dept. ☐

PLANNING DISTRICT # 20

COUNTY: NA

INDEPENDENT CITY: SUFFOLK

SAMPLING LOCATION: WESLEY LANE WELL (WELL HOUSE)

CODE: [ ][ ][ ]

SOURCE TYPE: ☒ Public Community ☐ Public-Noncommunity

FIELD TESTS: Temp: — pH: — Cl2: mg/L Alk: mg/L CO2 mg/L Hard: mg/L

P.W.S.I.D. #: 3 8 0 0 1 2 0

TRANSACTION CODE Ø 3

DATE COLLECTED: Mo 09 Day 25 Yr 89

TIME: 1150

COLLECTED BY: T. WERNER

CONTAINER TYPE: ☐ Glass ☒ Plastic

PRESERVATIVE USED: ☒ None ☐ Ice ☐ Other ☐ Nitric Acid

SAMPLE TYPE: D ☒ Reg. Dist. P ☐ Plant Tap R ☐ Raw Water C ☐ Check M ☐ MCL Check S ☐ Other

CONT. I.D.	CONTAMINANT NAME (Maximum Allowable Level)	MTD.	S	ANALYSIS RESULTS	PRECISION	ANALYSIS DATE (Mo Day Yr)	A*
4000	Gross Alpha 15 pCi/L	419		ØØ 04 ØØ	± Ø11	10 3 89	SAD
4010	Combined Radium 5pCi/L	420		ØØ ØØ	± Ø		
4020	Radium-226	421		ØØ ØØ	± Ø		
4030	Radium-228	422		ØØ ØØ	± Ø		
4100	Gross Beta 50 pCi/L	419		ØØ 44 ØØ	± Ø14	10 3 89	SAD
4006	Uranium			ØØ ØØ	± Ø		
4102	Tritium				±		

LAB I.D. 0 0 0 9 5

DATE REC. SEP 26 1989

DATE REP. OCT 0 3 1989

PREPARED BY: [illegible]

The results on this report are expressed in mg/l unless otherwise indicated. *A = analyst's initials

AR301655

LAB #: (1-6)

NAME OF WATER SYSTEM: City of Suffolk

SOURCE:

OTHER INFORMATION:

REPORT RESULTS TO HEALTH OFFICIAL AT:
Name: Virginia Beach Regional Office
Address:
City: Zip Code:

Water Quality Report

INORGANIC

WSE 50

Commonwealth of Virginia
Department of Health
Division of Water Programs
Bureau of Water Supply Engineering

REGION: (11) ☐ Abingdon ☐ Culpeper ☐ Danville ☐ Lexington ☐ Richmond ☒ Virginia Beach ☐ Local Health Dept. ☐

PLANNING DISTRICT #:

COUNTY:

INDEPENDENT CITY:

SAMPLING LOCATION: Wesley Lane

CODE: (18) Suffolk, VA

SOURCE TYPE: ☒ Public Community ☐ Public Noncommunity

FIELD TESTS: Temp: °F pH: Cl_2: mg/l Alk: mg/l CO_2: mg/l Hard: mg/l

P.W.S.I.D. #: (10-16)

TRANSACTION CODE: 3 (17-18)

DATE COLLECTED: Mo 08 Day 10 Yr 88 (19-24)

TIME: 1400 (25-28)

COLLECTED BY: JHM

CONTAINER TYPE:
☐ Glass
☒ Plastic

PRESERVATIVE USED:
☐ None
☒ Ice
☐ Other

SAMPLE TYPE:
D ☐ Reg. Dist.
P ☐ Plant Tap
R ☐ Raw Water
C ☐ Check
M ☐ MCL Check
S ☐ Other (29)

DATE REC: 8-10-88

DATE REP:

CONT. I.D.	CONTAMINANT NAME (Maximum Allowable Level)	MTD.	S	ANALYSIS RESULTS	PRECISION	ANALYSIS DATE Mo Day	A*
1925	pH (6.5-8.5)	135		7.5	@ 25°C	8 10 88	AB
1927	Alkalinity-Total	157		357	±	8 22 88	ama
1928	Alkalinity-Bicarbonate	157		357	±	8 22 88	ama
1929	Alkalinity-Carbonate	157	<	1	±	8 22 88	ama
1915	Hardness-EDTA	157		24.0	±	8 23 88	pb
1932	Acidity			∅	±		
1910	Corrosion Index	136		-1.42	±	8 29 88	mcc
1905	Fluoride 1.8	118		59.1	±	8 18 88	SR
1917	Chloride 250.	157		35.0	±	8 19 88	pb
1925	Color (APHA) 15 CU	129		5	±	8 10 88	SR
0110					±		
1907	Hydrogen Sulfide 0.05	157	<	0.5	±	8 26 88	ama
1916	Sulfate 250.	157		3	±	8 17 88	mmR
1810	Nitrogen-Nitrate 10.0	109		0.04	±	8 10 88	ama
1809	Nitrogen-Ammonia				±		
1808	Nitrogen-Nitrite				±		
1811	Nitrogen-Total Kjeldahl				±		
1903	Phosphate-Total (As P)				±		
1902	Phosphate-Ortho (As P)				±		
1946					±		
1930	Total Dissolved Solids (185°C)	139		132.4	±	8 11 88	mmR
1931	Volatile (550°C)	999		38.7	±	8 11 88	mmR
1950	Fixed (550°C)	549		54.1	±	8 11 88	mmR
1940	Silica (as SiO_2)			∅	±		
					±		
					±		
					±		

LAB I.D. 0280 (31-38)

PREPARED BY: JAMES R. REED AND ASSOCIATES, INC. (39-53)

The results on this report are expressed in mg/l unless otherwise indicated. *A = analyst's initials

C-34

AR301656

LAB #: (1-6)

NAME OF WATER SYSTEM: City of Suffolk

SOURCE:

OTHER INFORMATION:

REPORT RESULTS TO HEALTH OFFICIAL AT:
Name: VA Beach Regional Office
Address:
City: Zip Code:

Water Quality Report

METALS

WSE 50

Commonwealth of Virginia
Department of Health
Division of Water Programs
Bureau of Water Supply Engineering

REGION: ☐ Abingdon ☐ Culpeper ☐ Danville ☐ Lexington ☐ Richmond ☑ Virginia Beach ☐ Local Health Dept. ☐

PLANNING DISTRICT#

COUNTY:

INDEPENDENT CITY:

SAMPLING LOCATION: Wesley Lane

CODE: (7-9) Suffolk, VA

SOURCE TYPE: ☐ Public-Community ☐ Public-Noncommunity

FIELD TESTS: Temp: pH: Cl_2: mg/L Alk: mg/L CO_2: mg/L Hard: mg/L

P.W.S.I.D. #: (10-16)

TRANSACTION CODE: 03 (17-18)

DATE COLLECTED: Mo 08 Day 10 Yr 88 (19-24)

TIME: 1406 (25-28)

COLLECTED BY: JHM

CONTAINER TYPE: ☐ Glass ☑ Plastic

PRESERVATIVE USED: ☐ None ☑ Ice ☐ Other ☐ Nitric Acid

SAMPLE TYPE: 0 ☐ Reg. Dist. P ☐ Plant Tap R ☐ Raw Water C ☐ Check M ☐ MCL Check ☐ Other (29)

DATE REC: 8-10-88

DATE REP:

CONT. I.D. (30-33)	CONTAMINANT NAME (Maximum Allowable Level)	MTD. (39-41)	S	ANALYSIS RESULTS (43-50)	PRECISION (51-53)	ANALYSIS DATE Mo Day Yr (54-59)	A*
1005	Arsenic 0.05	125		∅∅∅∅002	±	08 15 88	mfc
1010	Barium 1.0	108	<	∅∅∅∅01	±	08 22 88	mfc
1015	Cadmium 0.010	125	<	∅∅∅∅007	±	08 17 88	SK
1020	Chromium 0.05	125	<	∅∅∅∅04	±	08 17 88	SK
1030	Lead 0.05	125		∅∅∅∅002	±	08 18 88	mfc
1035	Mercury 0.002	106	<	∅∅∅∅∅005	±	08 11 88	mfc
1045	Selenium 0.01	125	<	∅∅∅∅002	±	08 12 88	mfc
1050	Silver 0.05	125	<	∅∅∅∅01	±	08 17 88	SK
1002	Aluminum	108		∅ ∅∅	±		
1016	Calcium	108		∅ ∅∅	±		
1028	Iron 0.30	108	<	∅ 003 ∅∅	±	08 28 88	SK
1031	Magnesium	108		∅ ∅∅	±		
1032	Manganese 0.05	108		∅ 001 ∅∅	±	08 19 88	SK
1051	Strontium	108		∅ ∅∅	±		
1095	Zinc 5.0	108	<	∅ 001 ∅∅	±	08 16 88	SK
1022	Copper 1.0	108	<	∅ 001 ∅∅	±	08 16 88	SK
1042	Potassium	108		∅ ∅∅	±		
1052	Sodium 20.	108		∅17 ∅∅	±	08 17 88	SK
1036	Nickel	108		∅ ∅∅	±		
1006	Boron	108		∅ ∅∅	±		
1991	Calcium Hardness			3 ∅∅∅	±	08 22 88	cma
1981	Magnesium Hardness			∅∅∅	±		
1983	Ca & Mg Hardness			∅∅∅∅	±		
1985	Total Hardness ***			∅∅∅∅	±		
					±		
					±		

*** (Al, Ca, Fe, Mg, Mn, Sr, & Zn)

LAB I.D. 0100 (34-38)

PREPARED BY:

The results on this report are expressed in mg/L unless otherwise indicated. *A = analyst's initials

CITY OF SUFFOLK

P. O. BOX 1858, SUFFOLK, VIRGINIA 23434, PHONE (804) 934-3111

DEPARTMENT OF
PUBLIC UTILITIES

MEMORANDUM

DATE: September 12, 1988

TO: Assistant Director of Public Utilities

FROM: Line Maintenance Manager

RE: Wesley Lane Well

Please find listed below addresses of service connections for the Wesley Lane Well System.

108 Kings Highway - Village Drug
112 Kings Highway
114 Kings Highway
118 Kings Highway - Kitty's Salon
120 Kings Highway
6029 Meadowlot Lane
Meadowlot Lane - Brock
6045 Meadowlot Lane
6061 Meadowlot Lane
6073 Meadowlot Lane
6040 Meadowlot Lane
6036 Meadowlot Lane
6024 Meadlowlot Lane
129 Evergreen Lane
121 Evergreen Lane
132 Kings Highway
140 Kings Highway
152 Kings Highway
160 Kings Highway
168 Kings Highway
170 Kings Highway
172 Kings Highway
176 Kings Highway
200 Kings Highway
202 Kings Highway
Wesley Chapel Church
248 Kings Highway
260 Kings Highway

264 Kings Highway
217 Kings Highway
211 Kings Highway
201 Kings Highway
181 Kings Highway
161 Kings Highway
153 Kings Highway
141 Kings Highway
133 Kings Highway
117 Kings Highway
109 Kings Highway (Post Office)
5920 Chuckatuck Lane
5904 Chuckatuck Lane
5902 Chuckatuck Lane
5900 Chuckatuck Lane
5901 Chuckatuck Lane
5903 Chuckatuck Lane
5921 Chuckatuck Lane
5929 Chuckatuck Lane
6061 Wesley Lane
6053 Wesley Lane
200 Mulberry Lane
204 Mulberry Lane
208 Mulberry Lane
216 Mulberry Lane
177 Shell Road
149 Shell Road
145 Shell Road
143 Shell Road
141 Shell Road
137 Shell Road

CITY OF SUFFOLK

P. O. BOX 1858, SUFFOLK, VIRGINIA 23434, PHONE (804) 934-3111

DEPARTMENT OF
PUBLIC UTILITIES

MEMORANDUM

DATE: September 12, 1988

TO: Assistant Director of Public Utilities

FROM: Line Maintenance Manager

RE: Crumps Mill Well

Please find listed below addresses of service connections for the Crumps Mill Well System.

5881 Godwin Boulevard - Saunders Supply
5900 Godwin Boulevard
5912 Godwin Boulevard
5916 Godwin Boulevard
5920 Godwin Boulevard
5928 Godwin Boulevard
5936 Godwin Boulevard
5940 Godwin Boulevard
5956 Godwin Boulevard
5968 Godwin Boulevard
5969 Godwin Boulevard - Saunders Supply
5933 Godwin Boulevard - Holiday Food
112 Crumpler Lane
116 Crumpler Lane
120 Crumpler Lane
124 Crumpler Lane
126 Crumpler Lane
128 Crumpler Lane
132 Crumpler Lane
Godwin Boulevard - Volunteer Fire Department
5980 Godwin Boulevard
Godwin Boulevard - Service #35826
5989 Godwin Boulevard
M. L. Byrd - Service #35824
6020 Godwin Boulevard - 7-11
6021 Godwin Boulevard
6036 Godwin Boulevard
Creekmore Godwin

6072 Godwin Boulevard - Village Mill
6073 Godwin Boulevard
6075 Godwin Boulevard - Parks and Recreation
6205 Godwin Boulevard
6221 Godwin Boulevard
6229 Godwin Boulevard
6237 Godwin Boulevard
6245 Godwin Boulevard
6253 Godwin Boulevard
6257 Godwin Boulevard
6259 Godwin Boulevard
6273 Godwin Boulevard
6285 Godwin Boulevard
6301 Godwin Boulevard
6303 Godwin Boulevard
G. L. Gwaltney, Jr. - Service #35849
Godwin Boulevard - Service #35847

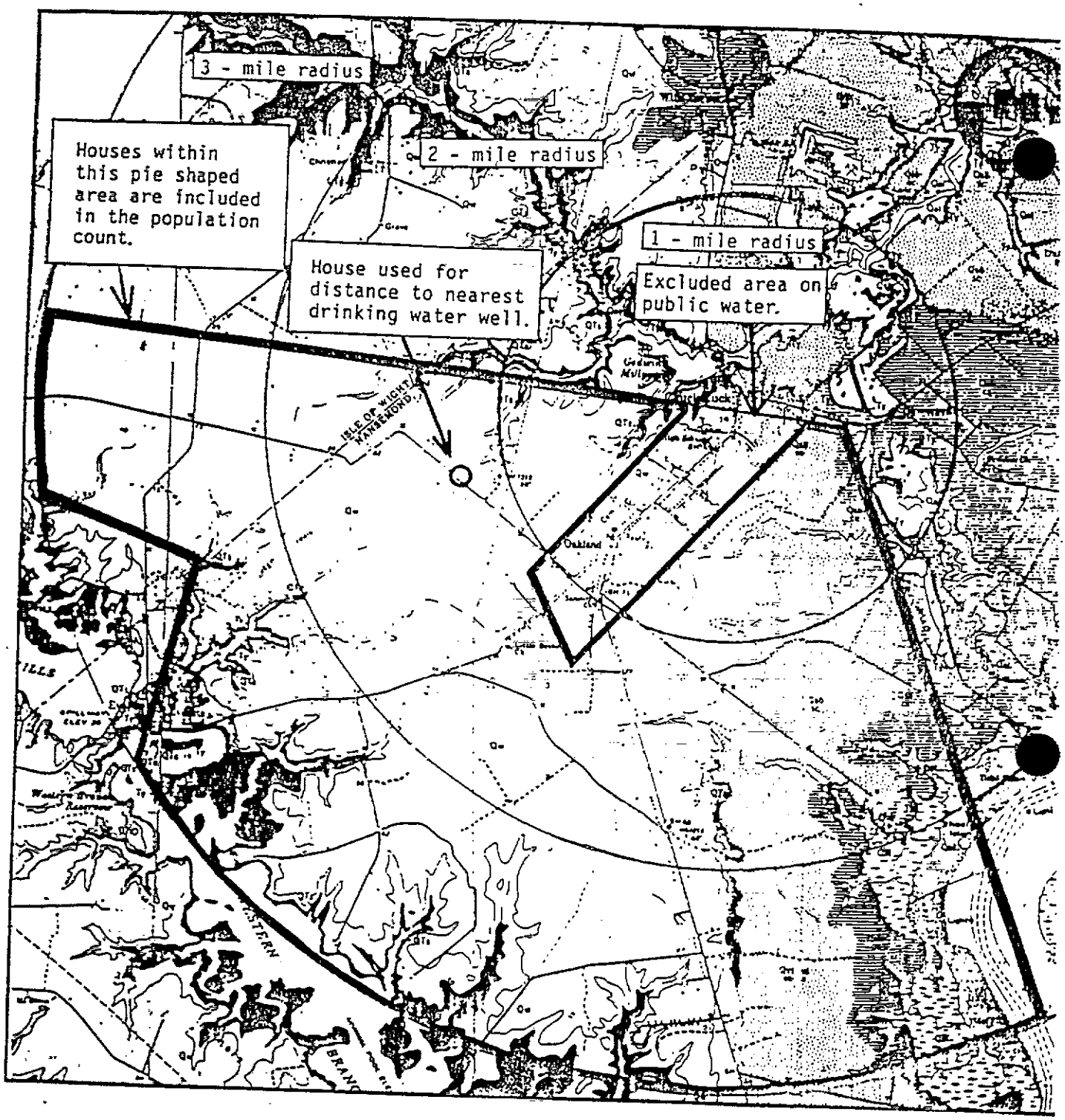


Figure 5: Potentially affected population drawing from the aquifer of concern within a 3 - mile radius of the site.

CONTACT REPORT

Telephone (X) Meeting ( ) Other ( )

AGENCY: Virginia State Water Control Board, Office of Water Resources Management

PHONE NO.: 804-367-0056

PERSON CONTACTED: Terry Wagner, Geologist C, Head of Resource Characterization Branch of Groundwater Program

TO: F. McKosky

FROM: J. Watson

DATE: February 28, 1990

SUBJECT: Groundwater Wells in Suffolk, Virginia

CC: G. Strobel, ZD-3081

The State Water Control Board (SWCB) has an automated data base of approximately 2-5% of individual private wells. A state regulation promulgated sometime prior to 1973 required individuals to report well construction data to the SWCB, but it has never been enforced. In 1983, a state law was promulgated that required individuals to report wells constructed in conjunction with septic systems (i.e., new houses). The regulation was promulgated for reporting to the SWCB, but responsibility was transferred in 1986 to the State Health Department. Between 1986 and now, the Health Department has been promulgating regulations, under this responsibility.

If an inventory of individual wells are necessary, a door-to-door survey would have to be conducted.

smj
CR/ZD-3081

CONTACT REPORT

Telephone (X) Meeting ( ) Other ( )

AGENCY: City of Suffolk, Department of Public Utilities

ADDRESS: G. Robert House Treatment Plant

PHONE NO.: 804/255-2247

PERSON CONTACTED: Eva Tillette, Water Treatment Specialist

TO: Fred McKosky

FROM: Jone Watson

DATE: February 20, 1990

SUBJECT: Water Supply System

CC: G. Strobel, ZD-3081

Primary sources for the City of Suffolk water supply are Godwin's Millpond and Lone Star Lakes. The average withdrawal is 3 million gallons/day, which is the capacity of the G. Robert House Treatment Plant. Approximately 95% of the year, the withdrawal is from Godwin's Millpond; 5% of the year withdrawal is from Lone Star Lakes. A population of 37,000 is served through this system. In May 1990, water supplies will be drawn from the groundwater through an electro dialysis reversal (EDR) process which removes the fluorides. A 900-foot well is on-site of the G. Robert House Treatment Plant. With expansion of the treatment plant, an additional 3 million gallons/day can be provided. The Village of Chuckatuck is supplied water by a 500 foot deep well in the Village which empties into a tank and supplied to the homes. This is a city-owned well system. By opening a valve, these homes can be put on city water.

In addition, the city of Suffolk has 18 wells which service individual developments/subdivisions. She is sending past monthly reports on water usage for the well in the Village of Chuckatuck; a map with highlighted areas serviced by city water systems and the most recent water quality analysis report. Areas not highlighted can be assumed to have private wells, except for homes along Route 10/32 which can elect to tie into the city's water main or have private wells.

smj
CR/ZD-3081

CORRESPONDANCE:
STATE RESOURCES AND SPECIES INFORMATION

COMMONWEALTH of VIRGINIA

Department of Game and Inland Fisheries

4010 WEST BROAD STREET
BOX 11104
RICHMOND, VA 23230
1-800-252-7717 (V/TDD)
(804) 367-1000 (V/TDD)

28 April, 1991

Larry G. Western
Ecology and Environment, Inc.
368 Pleasantview Drive
Lancaster, New York 14086

Mr. Western,

This letter is in response to your request for information on wildlife resources in the vicinity of Chuckatuck, Virginia.

An overview of the national forests and wildlife refuges for Virginia is included. Nansemond, Dismal Swamp, and Back Bay Wildlife Refuges are in the general area of Chuckatuck. The Dismal Swamp borders on southeast corner of Chuckatuck Quad.

There are no Wilderness Areas occurring in or near Chuckatuck, but Natural Areas are noted on another enclosed map. Once again, none of these areas are in the immediate vicinity of Chuckatuck.

No scenic rivers are in close proximity to Chuckatuck, although the Northwest and North Landing Rivers fall between Dismal Swamp and Back Bay. The Blackwater River is far west of Chuckatuck. These areas are indicated on the enclosed sheet.

Three species of special status are known or may be observed in the vicinity of Chuckatuck. As indicated on the comments, bald eagles do not nest in the area, but may be observed. Rafinesque's big-eared bats have been found along the edge of the Dismal Swamp, but are not known from Chuckatuck.

The Dismal Swamp southeastern shrew, federally threatened species, has been collected from Chuckatuck Quad, and should be considered in any environmental analysis. For additional information on this species please contact Don Schwab, Wildlife Biologist, at P.O.Box 847 Suffolk, Virginia 23434 or by phone at (804) 934-1577.

Habitat Profiles are included for these species of special status for your general information. A general overview of the area surrounding Chuckatuck (Hampton Roads) noting important outdoor areas is also enclosed.

This letter summarizes the natural areas and likelihood of occurrence of threatened or endangered fauna in the project vicinity. Please note that this response does not address all anticipated environmental impacts. These issues are analyzed by our Environmental Section, in conjunction with review of state or federal permit applications. If you have any questions in this regard, please contact Bill Neal, Environmental Coordinator, at (804) 367-8998.

Information on endangered plants and insects can be obtained from the Department of Agriculture, Office of Plant Protection, by contacting Marshall Trammell at P.O.Box 1163, Richmond, Virginia 23209 or by phone at (804) 371-0152.

The Department of Conservation and Recreation Division of Natural Heritage can conduct on-site surveys for rare, threatened, and endangered plants and animals as well as unique/exemplary natural communities and features. You may wish to contact Tom Smith, Inventory Manager at (804) 786-7951 for further information.

There is a processing charge of $25.50 for this response. Please remit a check made out to the Treasurer of Virginia within 30 days to Rebecca Wajda, FWIS Coordinator, at the address above. Include a copy of this letter with your payment to ensure that your account is properly credited.

If you have any questions or need additional information please give me a call at (804) 367-8747. We appreciate your interest in the wildlife resources of Virginia.

Sincerely,

Helen Elise Kitchel
Research Associate

cc: Bill Neal
Becky Wajda

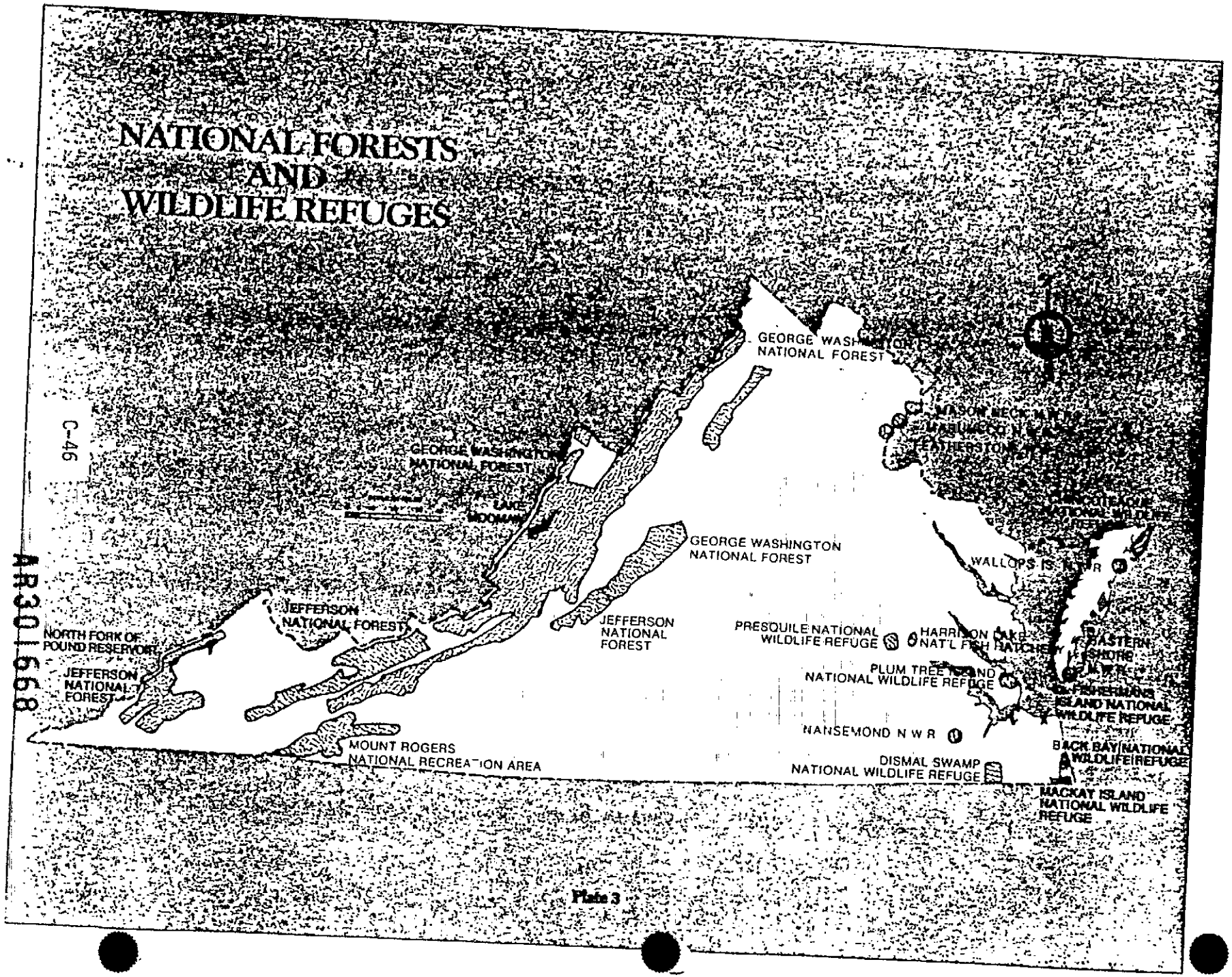


Plate 3

C-46

AR301668

NATURAL AREAS

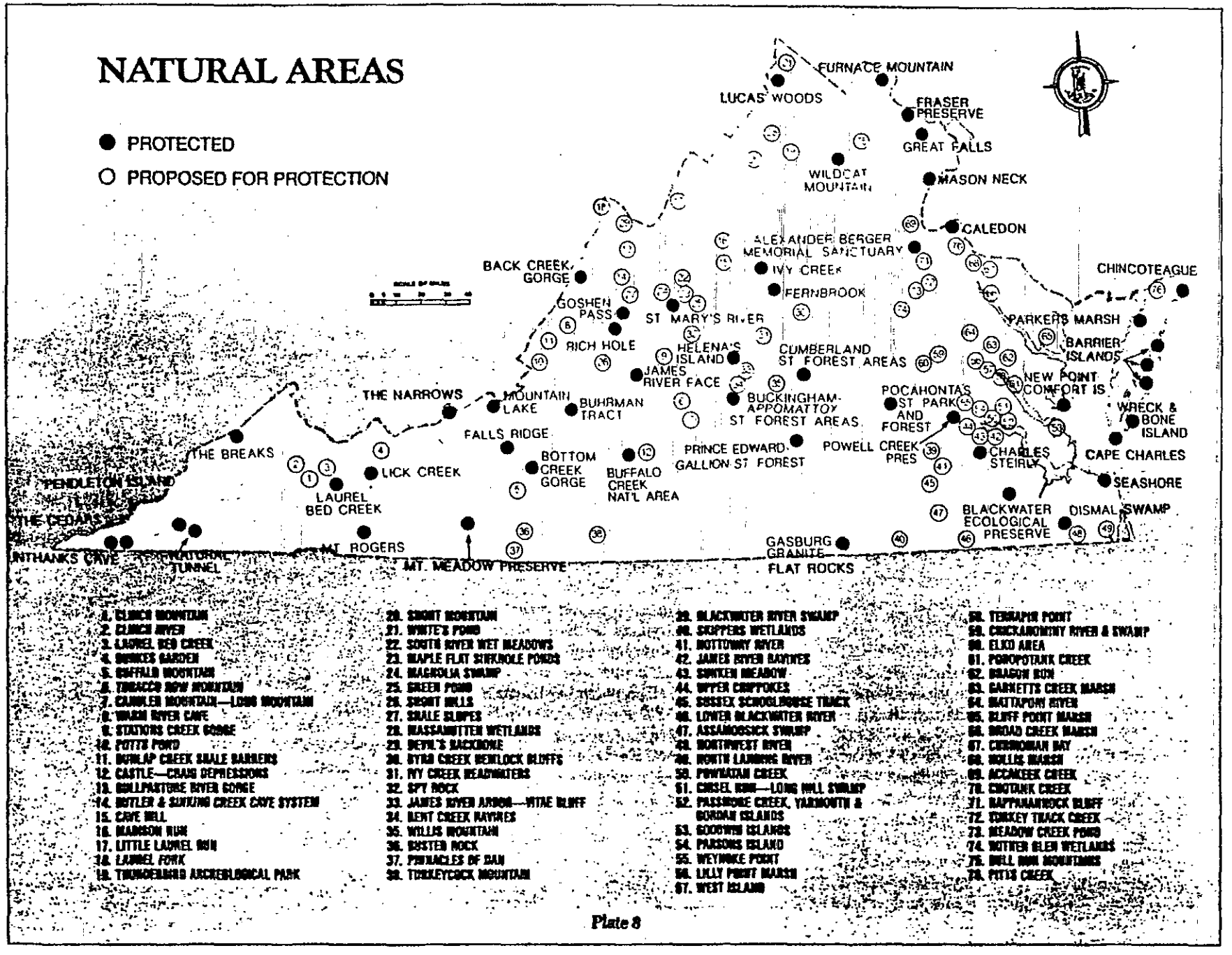
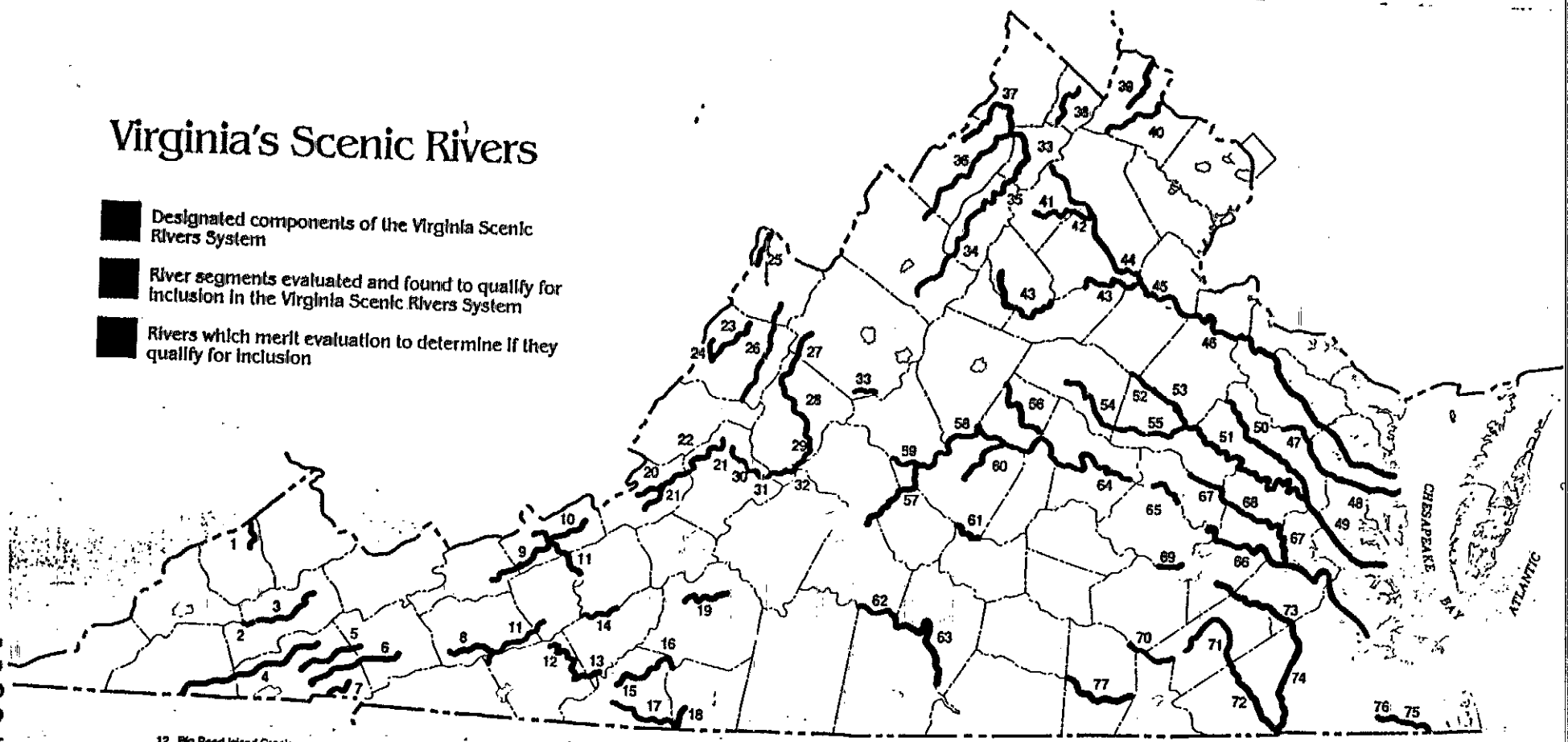


Plate 8

Virginia's Scenic Rivers

- Designated components of the Virginia Scenic Rivers System
- River segments evaluated and found to qualify for inclusion in the Virginia Scenic Rivers System
- Rivers which merit evaluation to determine if they qualify for inclusion



Breaks Interstate Park
uckett's Hole
Cleveland
e to Nash Ford
ion River
Tennessee Line
sion River
ord to South Holston
rion River
to South Holston Lake
Creek
n to vicinity of
New River
k to New River
k
New River
r to Allisonia
anding to Bluff City

12. Big Reed Island Creek
Route 753 to near Route 693
13. Laurel Fork
Headwaters to Big Reed Island Creek
14. Little River
Route 8 to Route 787
15. Smith River
Route 8 to Route 704
16. Smith River
Route 704 to Philpott Reservoir
17. South Mayo River
Stuart to North Carolina Line
18. North Mayo River
Route 695 to North Carolina Line
19. Blackwater River
Route 220 to Smith Mountain Lake
20. John's Creek
Craig Springs to New Castle
21. Craig Creek
Headwaters to Oriskany
Horton to Strom
22. Craig Creek
Oriskany to Horton
23. Jackson River
Route 623 to Lake Moomaw

24. Back Creek
Bolling Springs to Lake Moomaw
25. Laurel Fork
Headwaters to West Virginia Line
26. Cowpasture River
Route 614 near Patna to Route 42 in Bath County
27. Calfpasture River
Marble Valley to Goshen Pass
28. Maury River
Head of Goshen Pass to Lime Kiln Bridge
29. Maury River
Lexington to James River
30. James River
Near Eagle Rock to Springwood
31. James River
Springwood to Rocky Point
32. James River
Rocky Point to Snowden
33. St. Mary's River
Headwaters to George Washington National Forest Boundary
34. South Fork Shenandoah River
Port Republic to Goods Mill
Overall to Front Royal

35. South Fork Shenandoah River
Goods Mill to Overall
36. North Fork Shenandoah River
New Market to Riverton
37. Cedar Creek
Headwaters to North Fork Shenandoah River
38. Shenandoah River
Warren-Clarke County Line to Lockes Landing
39. Catoctin Creek
Waterford to the Potomac River
40. Goose Creek
Fauquier-Loudoun County Line to the Potomac
41. Thornton River
Fletcher's Mill to Route 729
42. Thornton River
Route 729 to the Hazel River
43. Rapidan River
Headwaters to town of Rapidan
Germanna Ford to the Rappahannock
44. Rappahannock River
Headwaters to Deep Run
45. Rappahannock River
Deep Run to Motts Run

46. Rappahannock River
Motts Run to Chesapeake Bay
47. Dragon Run
Headwaters to Plankatank River
48. Plankatank River
Dragon Run to Chesapeake Bay
49. York River
Entire River
50. Mattaponi River
Entire River
51. Pamunkey River
Entire River
52. North Anna River
Lake Anna to Route 738
Route 1 to Pamunkey River
53. North Anna River
Route 738 to Route 1
54. South Anna River
Polndexter to Route 673
Route 686 to Pamunkey River
55. South Anna River
Route 673 to Route 686
56. Rivanna River
Albemarle-Fluvanna County Line to James River

57. James River
Lynchburg to Wingina
58. James River
Wingina to Maidens
59. Tye River
Tye River P.O. to James River
60. Slate River
Route 20 to James River
61. Appomattox River
Route 612 to Route 606
62. Staunton River
Long Island to Brookneal
63. Staunton River
Brookneal to Kerr Reservoir
64. James River
Maidens to Watkins Landing
65. James River
Williams Island to Orleans Street
66. James River
Presquile to Hampton Roads
67. Chickahominy River
Route 630 to Route 609
Route 618 to James River
68. Chickahominy River
Route 609 to Route 618

69. Appomattox River
Lockes Dam to Route 36
70. Nottoway River
Route 609 to Route 630
71. Nottoway River
Stony Creek to Sussex-Southar
County Line
72. Nottoway River
Sussex-Southampton County L
North Carolina
73. Blackwater River
Headwaters to Zuni
Franklin to North Carolina
74. Blackwater River
Zuni to Franklin
75. Northwest River
Bunch Walnuts Road to Northw
River Park
76. Northwest River
Headwaters to Bunch Walnuts F
Northwest River Park to North
Carolina
77. Meherrin River
All in Brunswick County

June, 1

§ 10.1-413.2. North Landing and Tributaries Scenic River; the Department of Conservation and Recreation designated to administer. — A. The North Landing from the North Carolina line to the bridge at Route 165, the Pocaty River from its junction with the North Landing River to the Blackwater Road bridge, West Neck Creek from the junction with the North Landing River to Indian River Road bridge, and Blackwater Creek from the junction with the North Landing River to the confluence, approximately 4.2 miles, of an unnamed tributary approximately 1.75 miles, more or less, west of Blackwater Road, are hereby designated as components of the Virginia Scenic Rivers System.

B. The Department of Conservation and Recreation is designated to administer the North Landing and Tributaries Scenic River in accordance with this section.

C. The Governor, in consultation with the Director and the Cities of Virginia Beach and Chesapeake, shall appoint the North Landing and Tributaries Scenic River Advisory Board, which shall be composed of five area residents, including at least one riparian landowner, from within the designated section.

D. No dam or other structure impeding the natural flow of the river shall be constructed, operated, or maintained unless specifically authorized by an act of the General Assembly. (1988, cc. 490, 891; 1989, c. 656.)

Editor's note. — This section was enacted by Acts 1988, c. 490, as § 10-173.10. Pursuant to Acts 1988, c. 891, cl. 5, this section has been incorporated into Title 10.1 as § 10.1-413.2.

The 1989 amendment substituted "Recreation" for "Historic Resources" in subsection B.

§ 10.1-414. Nottoway State Scenic River; Sussex County Board of Supervisors designated to administer. — A. The Nottoway River in Sussex County, from the Route 40 bridge at Stony Creek to the Southampton County line, a distance of approximately thirty-three miles, is hereby designated a component of the Virginia Scenic Rivers System.

B. The Sussex County Board of Supervisors is designated to administer the Nottoway Scenic River in accordance with this section.

C. The Governor shall appoint the Nottoway State Scenic River Advisory Board. The Director shall make recommendations to the Governor after consulting with the Sussex County Board of Supervisors. The Advisory Board shall be composed of local residents, including at least three riparian landowners within the designated section. (1984, c. 739, § 10-173.6; 1985, cc. 346, 448; 1988, c. 891.)

§ 10.1-415. Rappahannock State Scenic River; Department of Game and Inland Fisheries designated to administer. — A. The mainstem of the Rappahannock River in Rappahannock, Culpeper and Fauquier Counties from its headwaters near Chester Gap to Deep Run is hereby designated a component of the Virginia Scenic Rivers System.

B. The Department of Game and Inland Fisheries is designated to administer the Rappahannock State Scenic River.

C. The Governor shall appoint a Rappahannock Scenic River Advisory Board. The Director shall make recommendations to the Governor after consulting with the affected county boards of supervisors. The Advisory Board shall be composed of local residents, including riparian landowners within the designated section. Each of the involved counties shall enjoy equal representation on the Advisory Board.

D. Nothing in this chapter shall preclude the continued operation and maintenance of existing dams in the designated section.

Species of Special status known or likely to occur in Suffolk - Chuckatuck Quad

NAME	SCIENTIFIC NAME	T.STATUS
Eagle, bald	Haliaeetus leucocephalis	Federal Endangered Federal Migratory Nongame-Protected

Comment - Although bald eagles may be observed in the area, none are known to nest in or near Chuckatuck Quad. See enclosed map and Habitat Profile for additional information.

Bat, Rafinesque's big-eared	Plecotus rafinesquii macrotis	Federal Candidate State Endangered Nongame-Protected

Comment - This species is known from near the Dismal Swamp in Suffolk, but has not been collected in Chuckatuck Quad. See enclosed Habitat Profile for additional information.

Shrew, Dismal Swamp southeastern	Sorex longirostris fisheri	Federal Threatened Nongame-Protected

Comment - This species has been collected in Chuckatuck Quad and adjacent quadrangles. See enclosed Habitat Profile for additional information.

Virginia Department of Game and Inland Fisheries

Federal and State Listed Threatened and Endangered Species in Virginia

FISHES:		
Chub, slender	Hybopsis cahni	Federal Threatened
Chub, spotfin	Hybopsis monacha	Federal Threatened
Darter, Carolina	Etheostoma collis lepidinion	State Endangered
Darter, Tippecanoe	Etheostoma tippecanoe	State Endangered
Darter, blueside	Etheostoma jessiae	State Endangered
Darter, sharphead	Etheostoma acuticeps	State Endangered
Logperch, Roanoke	Percina rex	Federal Endangered
Madtom, yellowfin	Noturus flavipinnis	Federal Threatened
Sturgeon, shortnose	Acipenser brevirostrum	Federal Endangered
Sunfish, blackbanded	Enneacanthus chaetodon	State Endangered
AMPHIBIANS:		
Salamander, Shenandoah	Plethodon nettingi shenandoah	Federal Endangered
Salamander, eastern tiger	Ambystoma tigrinum tigrinum	State Endangered
REPTILES:		
Turtle, bog	Clemmys muhlenbergi	State Endangered
Turtle, eastern chicken	Deirochelys reticularia reticularia	State Endangered
Turtle, hawksbill sea	Eretmochelys imbricata	Federal Endangered
Turtle, leatherback sea	Dermochelys coriacea	Federal Endangered
Turtle, loggerhead sea	Caretta caretta	Federal Threatened
Turtle, Atlantic green sea	Chelonia mydas mydas	Federal Threatened
Turtle, Kemp's Ridley sea	Lepidochelys kempi	Federal Endangered
BIRDS:		
Eagle, bald	Haliaeetus leucocephalis	Federal Endangered
Falcon, peregrine	Falco peregrinus	Federal Endangered
Plover, Wilson's	Charadrius wilsonia	State Endangered
Plover, piping	Charadrius melodus	Federal Threatened
Shrike, loggerhead	Lanius ludovicianus	State Endangered
Tern, roseate	Sterna dougallii	Federal Endangered
Warbler, Bachman's	Vermivora bachmanii	Federal Endangered
Warbler, Kirtland's	Dendroica kirtlandii	Federal Endangered
Woodpecker, red-cockaded	Picoides borealis borealis	Federal Endangered
Wren, Appalachian Bewick's	Thryomanes bewickii altus	State Endangered

09/15/90:rkw

Virginia Department of Game and Inland Fisheries

Federal and State Listed Threatened and Endangered Species in Virginia

MAMMALS:

Bat, Indiana	Myotis sodalis	Federal Endangered
Bat, Virginia big-eared	Plecotus townsendii virginianus	Federal Endangered
Bat, eastern big-eared	Plecotus rafinesquii macrotis	State Endangered
Bat, gray	Myotis grisescens	Federal Endangered
Cougar, eastern	Felis concolor cougar	Federal Endangered
Fisher	Martes pennanti pennanti	State Endangered
Shrew, Dismal Swamp southeastern	Sorex longirostris fisheri	Federal Threatened
Shrew, water	Sorex palustris punctulatus	State Endangered
Squirrel, Delarva Peninsula fox	Sciurus niger cinereus	Federal Endangered
Squirrel, northern flying	Glaucomys sabrinus	Federal Endangered

INVERTEBRATES:

Mussel, Appalachian monkeyface	Quadrula sparsa	Federal Endangered
Mussel, Cumberland bean	Villosa trabalis	Federal Endangered
Mussel, Cumberland combshell	Epioblasma brevidens	State Endangered
Mussel, Cumberland monkeyface	Quadrula intermedia	Federal Endangered
Mussel, James spiny	Pleurobema collina	Federal Endangered
Mussel, birdwing pearly	Lemiox rimosus	Federal Endangered
Mussel, crackling pearly	Hemistena lata	Federal Endangered
Mussel, dromedary pearly	Dromus dromus	Federal Endangered
Mussel, dwarf wedge	Alasmidonta heterodon	Federal Endangered
Mussel, fanshell	Cyprogenia stegaria	Federal Endangered
Mussel, fine-rayed pigtoe	Fusconaia cuneolus	Federal Endang
Mussel, green blossom	Epioblasma torulosa gubernaculum	Federal Endang
Mussel, little-wing pearly	Pegias fabula	Federal Endangered
Mussel, oyster	Epioblasma capsaeformis	State Endangered
Mussel, pink mucket	Lampsilis orbiculata orbiculata	Federal Endangered
Mussel, rough pigtoe	Pleurobema plenum	Federal Endangered
Mussel, shiny pigtoe	Fusconaia edgariana	Federal Endangered
Mussel, snuffbox	Epioblasma triquetra	State Endangered
Mussel, tan riffle shell	Epioblasma florentina walkeri	Federal Endangered
Snail, Virginia fringed mountain	Polygyriscus virginianus	Federal Endangered
Isopod, Madison Cave	Antrolana lira	Federal Threatened

MARINE MAMMALS:

Manatee, Florida	Trichechus manatus	Federal Endangered
Whale, blue	Balaenoptera musculus	Federal Endangered
Whale, fin	Balaenoptera physalus	Federal Endangered
Whale, humpback	Megaptera novaeengliae	Federal Endangered
Whale, northern right	Eubalaena glacialis	Federal Endangered
Whale, sei	Balaenoptera borealis	Federal Endangered
Whale, sperm	Physeter catodon	Federal Endangered

09/15/90:rkw

Definition of Abbreviations used on Element Lists
of the
Virginia Natural Heritage Program
Department of Conservation and Recreation

The following ranks are used by the Virginia Natural Heritage Program to set protection priorities. The primary criterion for ranking species is the number of occurrences, i.e. the number of known distinct localities. Also of great importance is the number of individuals in existence at each locality or, if a highly mobile organism (e.g., sea turtles, many birds, and butterflies), the total number of individuals. Other considerations may include the condition of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of occurrences such that ranks will be an index of known biological rarity.

S1 Extremely rare; usually 5 or fewer occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation.

S2 Very rare; usually between 5 and 20 occurrences; or with many individuals in fewer occurrences; often susceptible to becoming endangered.

S3 Rare to uncommon; usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large- scale disturbances.

S4 Common; usually >100 occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.

S5 Very common; demonstrably secure under present conditions.

SA Accidental in the state.

SH Historically known from the state, but not verified for an extended period, usually >15 years; this rank is used primarily when inventory has been attempted recently.

SN Regularly occurring migrants; transients; seasonal, nonbreeding residents. Usually no specific site can be identified with its range in the state. (Note that congregation and staging areas are monitored separately).

SU Status uncertain, often because of low search effort or cryptic nature of the element.

SX Apparently extirpated from the state.

Global ranks are similar, but refer to a species' rarity throughout its total range. Global ranks are denoted with a "G" followed by a character. Note that GA and GN are not used and GX means apparently extinct. A "Q" in a rank indicates that a taxonomic question concerning that species exists. Ranks for subspecies are denoted with a "T". The global and state ranks combined (e.g. G2/S1) give an instant grasp of a species' known rarity.

These ranks should not be interpreted as legal designations.

Federal Status

The Virginia Natural Heritage Program uses the standard abbreviations for Federal endangerment developed by the U.S. Fish and Wildlife Service, Division of Endangered Species and Habitat Conservation.

LE - Listed Endangered
LT - Listed Threatened
PE - Proposed Endangered
PT - Proposed Threatened
C1 - Candidate, category 1
C2 - Candidate, category 2
3A - Former candidate - presumed extinct
3B - Former candidate - not a valid species under current taxonomic understanding
3C - Former candidate - common or well protected
NF - no federal legal status

State Status

The Virginia Natural Heritage Program uses similar abbreviations for State endangerment.

LE - Listed Endangered
LT - Listed Threatened
C - Candidate
PE - Proposed Endangered
PT - Proposed Threatened
NS - no state legal status

The following status recommendations reflect the findings of the 1989 Virginia Endangered Species Symposium. THESE ARE NOT LEGAL DESIGNATIONS, NOR HAVE THE SPECIES YET BEEN FORMALLY PROPOSED.

RE - Recommended Endangered
RT - Recommended Threatened
RSC - Recommended Special Concern

For information on the laws pertaining to threatened or endangered species, contact:

U.S. Fish and Wildlife Service for all FEDERALLY listed species
Department of Agriculture and Consumer Services Plant Protection Bureau for STATE listed plants and insects
Department of Game and Inland Fisheries for all other STATE listed animals

11/90

BOVA Species Habitat Associations Profile
Species: Eagle, bald
Species Id 040093
Date 05/02/91

Name: Eagle, bald

Scientific Name: Haliaeetus leucocephalis leucocephalis

Status:

Federal Endangered
Plan approved by Director
Federal Migratory
Nongame-Protected
See Comments

General Comments on Habitat Associations: This species prefers coasts, lakes and rivers, and is seen along mountain ridges in migration *2802*. The James River is one of the more important eagle habitats in the state *4285*. Most nest sites are found in the midst of large wooded areas adjacent to marshes or bodies of water, or in isolated trees located in marshes, on farmland, or in logged over areas where scattered seed trees remain. Most eagle nests are less than 1.6 km from feeding areas, but some nests are between 1.6 and 3.2 km from the primary food sources *9551*. Pines are often the prefered nest trees in the eastern United States but oaks and other narwoods are also used in the Chesapeake Bay area. Wintering areas have many of the same charactoristics of the nest sites. Roost sites are important in wintering areas. Their habitat usually occurs in undeveloped areas with little human activity *8814*.

HABITAT ASSOCIATIONS

U.S. Forest Service Forest Size Class

Pole
Mature
Over Mature

Society of American Foresters' Forest Cover Types

Baldcypress, young tree, canopy unknown

Land Use

Agricultural Land
Cropland and Pasture
Deciduous Forest Land
Evergreen Forest Land
Water
Streams and Canals
Lakes
Reservoirs
Mixed Forest Land
Nonforested Wetland
Forested Wetland
Forest Land

BOVA Species Habitat Associations Profile
Species: Bat, Rafinesque's big-eared
Species Id 050034
Date 05/02/91

Name: Bat, Rafinesque's big-eared

Scientific Name: Plecotus rafinesquii macrotis

Status:

Federal Candidate
State Endangered
Heritage G4 - Apparently secure globally
Heritage SH - Historic occurrence in state

General Comments on Habitat Associations: Plecotus rafinesquii (macrotis and rafinesquii) occurs in nearly every forest association throughout most of Astroriparian and Carolinian biotic provinces of the southeastern U.S. *176*. The eastern big-eared bat is incidental in Virginia because it has adapted to temporate, arboreal zones found only in the extreme southeast *252*. The Dismal Swamp specimen was found in a hollow cypress snag. Elsewhere they use the space under loose tree bark or buildings *8905*. P.r. macrotis is most often found in houses, or sometimes in hollow trees, behind loose bark, in culverts, or in caves and mines *252*.

HABITAT ASSOCIATIONS

U.S. Forest Service Forest Size Class

Society of American Foresters' Forest Cover Types

Land Use

National Wetlands Inventory Codes
(System, Class, Water Regime, Special Modifier)

MANAGEMENT PRACTICES

Beneficial, Prohibiting harvest of species being described
Beneficial, Restricting/regulating human use of habitats
Beneficial, Restricting/regulating human disturbance of populations
Beneficial, Maintaining undisturbed/undeveloped areas
Beneficial, Creating/maintaining snags
Beneficial, Maintaining large trees for denning, nesting, or roosting
Beneficial, Controlling pollution [thermal, chemical, physical]
Beneficial, Other management practices [specified in comments]
Beneficial, Maintaining unique or special habitat features [wetlands,
Adverse, Timber harvesting - clearcutting
Adverse, Applying pesticides
Adverse, Applying insecticides
Adverse, Other management practices [specified in comments]

BOVA Species Habitat Associations Profile
Species: Shrew, Dismal Swamp southeastern
Species Id 050008
Date 05/02/91

Name: Shrew, Dismal Swamp southeastern

Scientific Name: Sorex longirostris fisheri

Status:

Federal Threatened
See Comments

General Comments on Habitat Associations: They occur from grassy openings through closed forests although they are most numerous in openings "248". They are associated with a heavy ground cover "117". They are found in various habitat types "116". They are nearly always found with heavy ground cover of Japanese honeysuckle "116". The greatest numbers are from moist to wet areas, usually bordering swamps, marshes, or rivers "117". They are able to occupy a wide range of habitats "8889". In general, the highest densities are observed in early successional stage habitats, and lowest densities are in mature forests. Despite supporting lower densities, mature forests may be important to the survival of these shrews during periods of drought or fire "8889".

HABITAT ASSOCIATIONS

U.S. Forest Service Forest Size Class

Unstocked
Seedling
Sapling
Seedling/Sapling
Pole
Mature

Society of American Foresters' Forest Cover Types

Loblolly pine
Sweetgum-yellow poplar
Sweetgum-willow oak
Atlantic white cedar
Baldcypress
Red maple

Land Use

Rangeland
Herbaceous Rangeland
Shrub and Brush Rangeland
Mixed Rangeland
Wetland
Forested Wetland
Nonforested Wetland
Forest Land

BOVA Species Habitat Associations Profile
Species: Eagle, bald
Species Id 040093
Date 05/02/91

Wetland
Rangeland
Herbaceous Rangeland
Shrub and Brush Rangeland
Mixed Rangeland
Bays and Estuaries
Chesapeake Bay
Atlantic Ocean Coastal Waters
Barren Land
Beaches
Mixed Barren Land

National Wetlands Inventory Codes
(System, Class, Water Regime, Special Modifier)

Marine, intertidal, Rocky shore, boulder

MANAGEMENT PRACTICES

Beneficial, Restricting/regulating human use of habitats
Beneficial, Developing/maintaining water holes, ponds, potholes, etc.
Beneficial, Maintaining/protecting riparian habitats
Beneficial, Maintaining wilderness environment
Beneficial, Maintaining overmature forests
Beneficial, Prohibiting harvest of species being described
Beneficial, Transplanting wild animals
Beneficial, Stocking captive-reared wild-strain animals
Beneficial, Restricting/regulating human disturbance of populations
Beneficial, Maintaining undisturbed/undeveloped areas
Beneficial, Maintaining unique or special habitat features [wetlands,
Beneficial, Maintaining large trees for denning, nesting, or roosting
Beneficial, Establishing buffer zones
Beneficial, Other management practices [specified in comments]
Beneficial, Maintaining natural vegetation [native]
Beneficial, Supplemental feeding [winter, spring, etc.]
Beneficial, Developing/maintaining submerged brush, timber, debris, et
Beneficial, Providing artificial nesting/spawning sites
Beneficial, Developing/maintaining greenspace [wildlife corridors]
Beneficial, Developing/maintaining stream bank vegetation
Beneficial, Developing/maintaining stream structures
Beneficial, Stream bank protection - gabion matting or riprap
Beneficial, Controlling sedimentation
Beneficial, Controlling water levels
Beneficial, Controlling wind and water erosion
Adverse, Maintaining early stages of ecological succession
Adverse, Locating/constructing roads
Adverse, Applying pesticides
Adverse, Other management practices [specified in comments]
Adverse, Locating/constructing powerlines and other rights-of-way
Adverse, Timber harvesting - clearcutting
Adverse, Construction of navigational improvements [dams, locks, etc.]
Adverse, Dredging
Adverse, Applying insecticides
Adverse, Surface mining

BOVA Species Habitat Associations Profile
Species: Shrew, Dismal Swamp southeastern
Species Id 050008
Date 05/02/91

Evergreen Forest Land
Mixed Forest Land

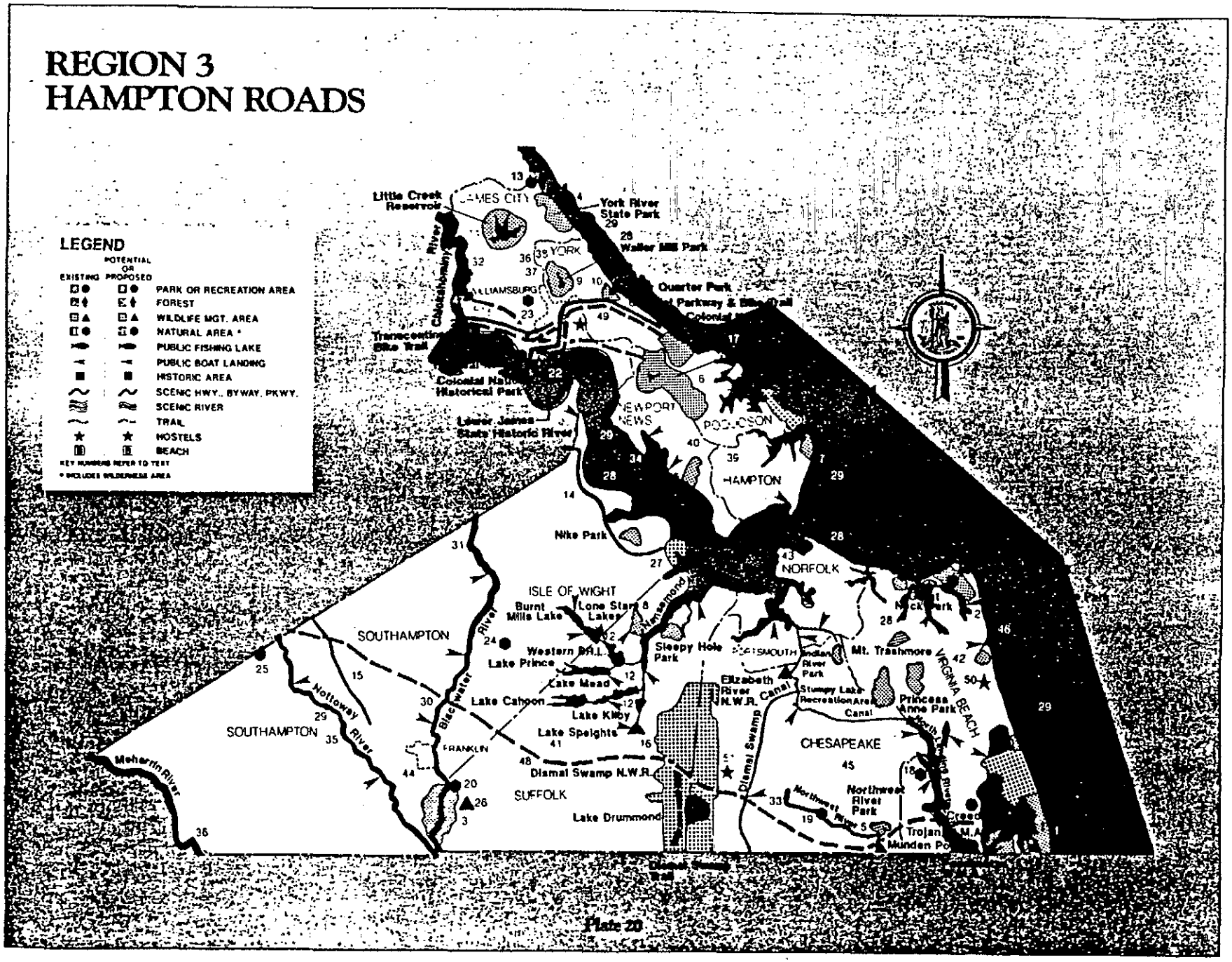
National Wetlands Inventory Codes
(System, Class, Water Regime, Special Modifier)

Palustrine
Palustrine, Forested
Palustrine, Forested, deciduous
Palustrine, Forested, evergreen
Palustrine, Forested
Palustrine, Forested, broad-leaved deciduous
Palustrine, Forested, needle-leaved deciduous
Palustrine, Forested, broad-leaved evergreen
Palustrine, Forested, needle-leaved evergreen
Palustrine, Forested, dead
Palustrine, Forested, deciduous
Palustrine, Forested, evergreen
Palustrine, Moss/lichen
Palustrine, Moss/lichen, moss
Palustrine, Moss/lichen, lichen
Palustrine, Scrub/shrub
Palustrine, Scrub/shrub, broad-leaved deciduous
Palustrine, Scrub/shrub, needle-leaved deciduous
Palustrine, Scrub/shrub, broad-leaved evergreen
Palustrine, Scrub/shrub, needle-leaved evergreen
Palustrine, Scrub/shrub, dead
Palustrine, Scrub/shrub, deciduous
Palustrine, Scrub/shrub, evergreen

MANAGEMENT PRACTICES

Beneficial, Maintaining undisturbed/undeveloped areas
Beneficial, Maintaining early stages of ecological succession
Beneficial, Developing/maintaining edge [ecotones]
Beneficial, Maintaining unique or special habitat features [wetlands,
Beneficial, Developing/maintaining freshwater marsh
Beneficial, Maintaining bogs
Beneficial, Developing/maintaining/protecting wetlands
Beneficial, Developing/maintaining forest openings
Beneficial, Timber harvesting - clearcutting
Adverse, Draining wetlands, marshes, ponds, lakes
Adverse, Suppressing wildfire
Adverse, Applying herbicides
Adverse, Applying pesticides
Adverse, Applying insecticides

REGION 3
HAMPTON ROADS



Virginia Department of Game and Inland Fisheries

Threatened and Endangered Faunal Species

Fact Sheet

Since its inception in 1916, the Virginia Department of Game and Inland Fisheries has been the state's regulatory agency charged with the conservation of wildlife. In 1973, more specific legislation was passed, further enabling and providing for the management and protection of threatened and endangered faunal species occurring in the Commonwealth (Code of Virginia, Section 29.1, Article 6). A Nongame and Endangered Species Program was established in 1980 through the creation of the Nongame Fund. The first official list of state endangered and threatened species was passed in 1987, which adopted the Federal Endangered and Threatened Species List and listed 20 additional species as "State Endangered" (VR 325-01.1, Section 13; 3:26:3045). Presently, there are 62 federal and state listed faunal species protected in Virginia.

Several definitions and policies have been developed and implemented to assist the Department in the management of threatened and endangered species, and should be considered in all activities where such species may be a factor. Definitions for "endangered species" and "threatened species" may be found in the Code of Virginia (Section 29.1-563). Definitions for "special concern," "take," "harm," and "harass" also have been adopted (VR 325-01, Section 14).

The taking, transportation, sale, or offer for sale of any endangered faunal species is specifically prohibited in the Commonwealth unless an endangered species collection permit has been issued by the Department's designated contacts (Code of Virginia, Section 29.1-568). All requests for endangered species permits must be made in writing and include a study proposal, justification of benefit to the species, and risk assessment. The Department's contact for permit requests concerning mammalian, avian, or terrestrial invertebrate species is: Karen Terwilliger, Wildlife Division, VA Department of Game and Inland Fisheries, 4010 W. Broad St., Richmond, VA 23230 (804) 367-1000. The Department's contact for permit requests concerning aquatic or herpetological species is: David Whitehurst, Fish Division, VA Department of Game and Inland Fisheries, 4010 W. Broad St., Richmond, VA 23230 (804) 367-1000.

Requests for specific information about any threatened or endangered species should be submitted, in writing, through the agency's FWIS Coordinator, Rebecca Wajda. Any proposed projects which modify or alter existing land uses in areas where threatened or endangered species are known or likely to occur must be presented to the Department's Environmental Officer, William Neal, for an environmental assessment. Requests should be in writing and include a map of the proposed project area and a general habitat description. Both of these individuals may be reached at: VA Department of Game and Inland Fisheries, 4010 W. Broad St., Richmond, VA 23230 (804) 367-1000.

Any questions concerning legal issues or penalties should be directed to the Law Enforcement Division, at the address and phone number above.

RKW:01/16/90

B. C. LEYNES, JR.
Director

ADMINISTRATION
NATURAL HERITAGE
PLANNING AND RECREATION RESOURCES
SOIL AND WATER CONSERVATION
STATE PARKS

COMMONWEALTH of VIRGINIA

DEPARTMENT OF CONSERVATION AND RECREATION

DIVISION OF NATURAL HERITAGE

203 Governor Street, Suite 402

TDD (804) 786-2121 Richmond, Virginia 23219 (804) 786-7951 FAX: (804) 786-6141

April 22, 1991

Steven Peterson
Ecology and Environment, Incorporated
368 Pleasantview Drive
Lancaster, NY 14086

re: Superfund Site at Chuckatuck, Virginia

Dear Dr. Peterson:

The Virginia Department of Conservation and Recreation's Division of Natural Heritage (DNH) has processed your recent request for information.

DNH's Biological Conservation Datasystem contains no records for natural heritage resources (rare species, exemplary natural communities, and significant geologic features) from the site you indicated on the submitted map. Our Biological Conservation Datasystem does, however, contain records for the following natural heritage resources from within a fifteen mile surface water range of the site:

Fundulus lineolatus, the lined topminnow, G5/S1/NF/NS
Etheostoma serriferum, the sawcheek darter, G5/S3/NF/NS
Stygobromus indentatus, the Tidewater amphipod, G?/S1/C2/NS

An explanation of species rarity ranks and legal status abbreviations is enclosed for your reference. Please note that S. indentatus has federal candidate status.

Any absence of natural heritage resource data does not necessarily mean that other natural heritage resources do not occur in the project area, but rather that our files do not currently contain information documenting the presence of them. DCR's Biological Conservation Datasystem is constantly growing and revised. Please contact DCR for an update on this natural heritage information if a significant amount of time passes before it is utilized.

A fee of $50.00 has been assessed for the service of providing this information. Please find enclosed an invoice for that

amount. Please return the yellow copy of the invoice along with your remittance made payable to the Treasurer of Virginia to the Department of Conservation and Recreation, Post Office Box 721, Richmond, VA 23206-0721, ATTN: Elsie Marsh. Payment is due within thirty days of the invoice date.

Please do not hesitate to contact us if you have any questions regarding the interpretation of this information or the billing procedure. Thank you for your interest in Virginia's natural heritage.

Sincerely,

Kennedy H. Clark
Environmental Review Coordinator

enclosure

cc: Elsie Marsh, DCR

dnhref:91-0514

APPENDIX D

X-RAY FLUORESCENCE REPORT

Saunders

SITE SCREENING REPORT OF SAUNDERS SUPPLY COMPANY, INC. SUFFOLK, VIRGINIA

by

X-Ray Fluorescence Team
Lockheed Engineering & Sciences Company
1050 E. Flamingo, Suite 120
Las Vegas, Nevada 89119

Prepared for

A. Palestini, Regional Project Manager
U.S. Environmental Protection Agency, Region III
841 Chestnut Street
Philadelphia, Pennsylvania 19107

through

K. R. Scarborough
Superfund Technical Support Center
Environmental Monitoring Systems Laboratory
Office of Research and Development
U. S. Environmental Protection Agency
Las Vegas, Nevada 89119

Las Vegas Project Officers
L.A. Eccles and W. H. Engelmann
Advanced Monitoring Systems
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada 89119

EPA
Contract Number
68-03-3245

SUMMARY

Saunders Supply Corporation is a lumber and hardware retail store located north of Suffolk, VA in the town of Chuckatuck (see site location map). In 1964, SSC began a wood treating process which included the use of a 5% pentachlorophenol (PCP) solution in a No. 2 fuel oil base. In 1974, SSC began converting the PCP solution to a chromated copper arsenate (CCA) solution. The sludge from the treatment process was periodically sprayed on the service roads of the site for dust and weed control until 1981. The water fraction from the treatment process flowed into a cooling pond located on the northwest corner of the site. This cooling pond was periodically discharged into a stream which discharges into Goodwins Millpond, a drinking water source for the City of Suffolk. In 1981, sampling revealed PCP contamination in the soils and groundwater on the SSC site. Further sampling revealed low concentrations of copper arsenic and chromium in soil.

In an effort to understand the spatial distribution of arsenic, chromium and copper on the SSC site, EPA Region III, through the Superfund Technology Transfer program, requested assistance from the EMSL-LV X-Ray Team. This report contains the data obtained from the screening effort conducted in May 1989. This effort employed field-portable x-ray fluorescence (FPXRF) technology. The data obtained from FPXRF was used to construct an arsenic concentration isopleth map for the SSC site.

One hundred sixty-nine sample locations were analyzed in triplicate. Of these sample locations, only seven of the mean values were above the Limit of Quantitation for arsenic, 1 for chromium and none for copper. As a result, most of the data presented in this report is semiquantitative. Much of the data is below the Instrument Detection Limit. Anyone intending to use this data should carefully read the section entitled Detection Limits.

CONTENTS

Sheet A

Information and Regional Request

EPA Region: III Project Manager: Palestini

Site Name: Saunders Supply Location/address: Norfolk, VA

Site Protection Level: A B C D E

Time Frame: from 5/30/89 to 6/1/89.

PRP: Saunders Supply Company, Inc.

EPA on-site Contractor: Ecology and Environment

Elements sought:

Arsenic, Copper, Chromium.

Cu and Cr are below the instrument detection limits. Arsenic values range from slightly above the limit of quantitation of the instrument to below the detection limit.

Description of Work Requested: Surface screening for the elements listed above.

Prepared and signed by: Date:

Sheet B

Site Reconnaissance

Site Name: Saunders Supply EPA Region: III

Reconnaissance Team: Cole, Kuharic, Duggan

Date: March 5, 1989

Site Information:

Is Site still in operation? yes Limited Access? With permission

Structures or other obstructions:

Buildings: Several existing buildings and concrete pads.

Geological/Morphological: Relatively flat with a gentle slope to the northwest. There is a small pond on the northwestern property boundary.

Vegetation: There is a wooded area off of the western property boundary, but only sparse closely cropped grasses on the site.

Weather:

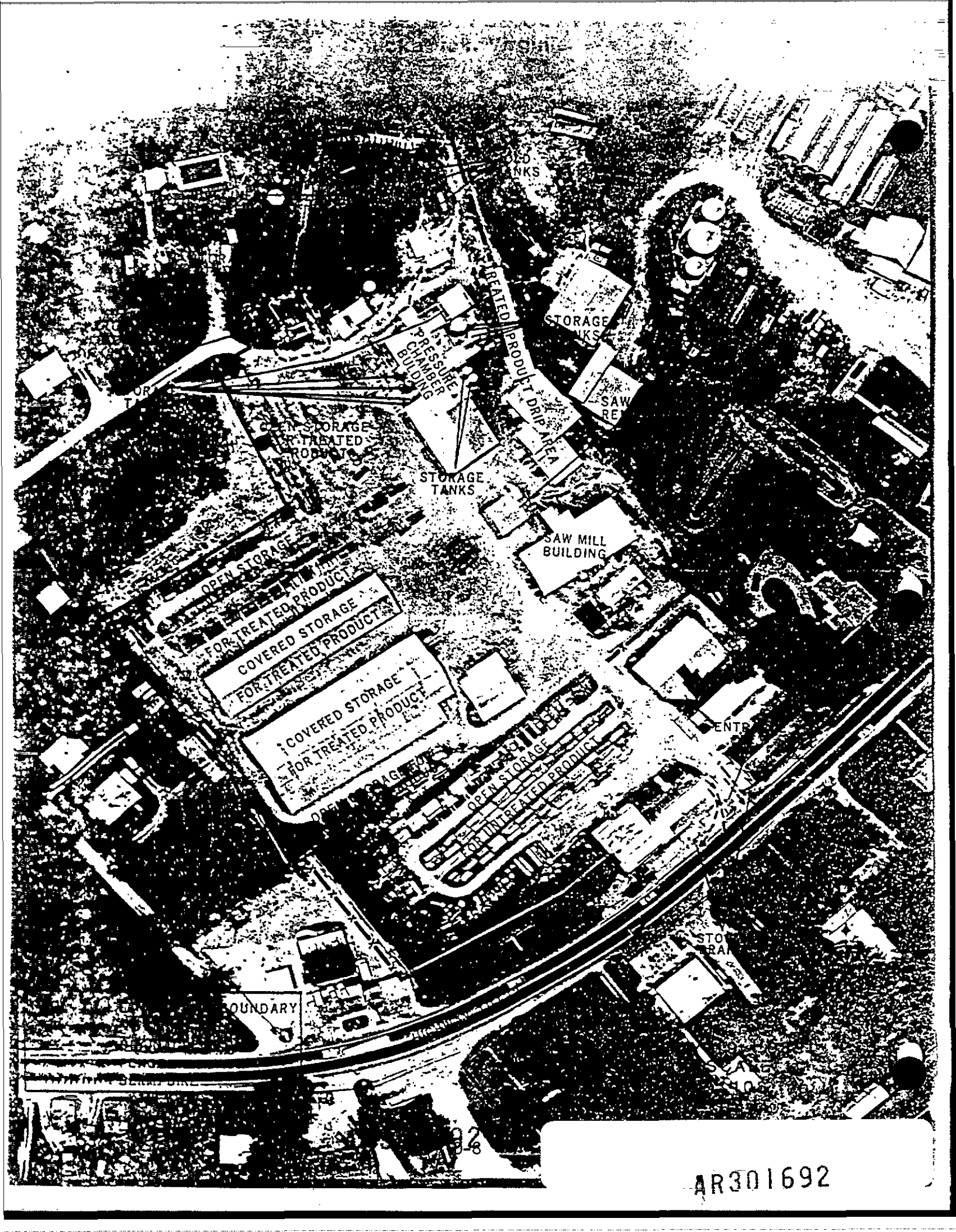
Proximity to Commercial, Residential Areas, Schools, Parks, etc.: The eastern property line is State Route 10/32. To the north is Kelly Nursery and to the south is Supreme Petroleum and a residential subdivision. To the west is a wooded area and a stream which discharges into Godwins Millpond, a drinking water source for Suffolk.

Size of Site: 7.3 acres

Availability of prior reports and data?
Keystone Environmental Resources, Inc., 1988, Saunders Supply Company, Inc., RI/FS Work Plan.

History: see summary

Comments: Chromium and copper from the chromated copper arsenate (CCA) appear to be well below the XMET quantitation limits. The only analyte we may be able to quantify is arsenic, though it appears to be in such low concentrations that the majority of our in situ analyses may be non-detects.


STORAGE TANKS
TREATED PRODUCT DRIP AREA
PRESSURE CHAMBER BUILDING
STORAGE TANKS
SAW MILL BUILDING
OPEN STORAGE FOR TREATED PRODUCT
COVERED STORAGE FOR TREATED PRODUCT
COVERED STORAGE FOR TREATED PRODUCT
OPEN STORAGE FOR UNTREATED PRODUCT
ENTR
OUNDARY

AR301692

Sheet C

Data Quality Objective Summary Form

1. Site: Saunders Supply EPA Region: III

   Location: Norfolk, VA Phase: RI1, RI2, FS,

2. Media: soil, ground water, surface water/sediment, air, biological, other (specify)

3. Use: Site Charac., Risk Assess., Eval. Alts., Eng'g Design, Monitoring Remedial Action, other (specify):

4. Site Information:
   Area: 7.3 acres
   Depth to ground water: approx. 6 feet
   Ground water use: The Kelly Nursery wells draw from the surficial aquifer.
   Soil Types: Fine to medium sand with varying amounts of gravel, silt and clay.

5. Data types:

A. Analytical Data			B. Physical Data	
pH	Pesticides	TOX	Permeability	Hydraulic head
conductivity	PCB	TOC	Porosity	Penetration test
VOA	Metals	BTX	Grain size	Hardness
ABN	Cyanide	COD	Bulk density	

6. Sampling Method to be Used:

Environmental Source	Biased Grid	Grab Composite	Non-intrusive Intrusive	Phased Cores

7. Analytical Levels (indicate level and equipment to be used):
   Level 1, 2, 3, 4, or 5

8. Sampling procedures:
   Strictly in situ analyses. No physical samples to be taken.

Prime Contractor: Ecology and Environment, Inc.

Site manager:_____ Date:_____

Sheet D

PRINCIPLES OF X-RAY FLUORESCENCE

X-ray fluorescence (XRF) is based on the principle that photons produced from an X-ray tube or radioactive source bombard the sample to produce fluorescence. The incident photons impinge on the electron cloud of the atom. Among other events, this process creates vacancies in one or more of the inner shells. The vacancies cause instability within the atom. As the outer electrons seek stability by filling the vacancies in the inner shells, the atom emits energies as X-ray photons. The emitted energy (fluorescence) from a particular shell is characteristic of the atom in which it was produced and is equal to the difference in bonding energy between the outer shell electron and the vacant shell. Most elements under the photon bombardment fluoresce simultaneously to produce a spectrum of characteristic radiation. It is this spectrum that the detector senses and counts.

There are two types of XRF spectrometers, energy dispersive and wavelength dispersive. The principal differences are in the method of detection of the fluorescent energies of the specimen and the method of quantifying the analytes of interest. The field portable XRF instrument used in this program is an energy dispersive spectrometer.

The XMET-880:
Field Portable X-ray Fluorescence Spectrometer

The X-Met 880 is a field portable, energy dispersive X-Ray fluorescence spectrometer marketed by Columbia Scientific Industries Corporation, Austin, TX. The unit is self-contained, battery powered, microprocessor based and weighs 8.5 kg. The surface analysis probe is specifically designed for field use. The X-Met 880 is hermetically sealed and can be decontaminated with soap and water. The probe includes a radioisotope source of Curium-244, a proportional counter and the associated electronics. The source is protected by an NRC-approved safety shutter.

The electronic unit has thirty-two calibration memories called 'models'. Each model can be independently calibrated for as many as six elements. These can be used to measure elements from silicon to uranium assuming the proper isotope source is available. The unknown sample intensities are regressed against the calibration curves to yield concentrations.

For the Saunders site, arsenic, copper and chromium were investigated.

Sheet E

Calibration Curve and Calibration Confirmation

Elements Sought:
1. Arsenic
2. Copper
3. Chromium

Concentrations of Calibration Standards:

Nine site specific samples were selected as representative samples to be used in calibrating the XMET. The 'actual' values were obtained from CLP analysis at the EMSL-LV laboratory. The extraction procedure was a complete hydrofluoric acid digestion in a Parr bomb. The 'measured' values are the confirmation readings on the calibration curve programmed into the XMET (ie. once the calibration curve was established, the standards were run against the curve to check for accuracy of the fit).

The following curve confirmation was done on 5/30/89.

samp. no.	Actual As	Cu	Cr
1.	9.4	3.6	3.1
2.	45.1	50.5	33.4
3.	33.9	13.6	23.1
4.	107.7	106.2	165.5
5.	25.8	46.5	90.2
6.	60.1	90.4	66.8
7.	27.2	207.7	18.2
8.	22.5	4.3	3.6
9.	28.9	27.1	50.6

samp. no.	Measured (in triplicate) As	Cu	Cr
1.	8 ± 7	24 ± 19	13 ± 7
2.	55 ± 11	51 ± 44	36 ± 8
3.	38 ± 6	41 ± 29	26 ± 13
4.	100 ± 4	54 ± 41	53 ± 12
5.	31 ± 9	70 ± 13	59 ± 7
6.	26 ± 11	90 ± 45	66 ± 1
7.	21 ± 4.	13 ± 7	26 ± 12
8.	15 ± 2	11 ± 10	13 ± 13
9.	27 ± 5	29 ± 23	5 ± 8

THE PLOTTED CALIBRATION CURVES FOR THE THREE ANALYTES CAN BE FOUND IN APPENDIX B.

Sheet F

Detection Limits

The American Chemical Society (ACS) defines a limit of detection as "...the lowest concentration level that can be determined to be statistically different from a blank"(1). This is further defined as three times the standard deviation of a series of blanks (3 sigma).

The ACS defines a limit of quantitation as "...the level above which quantitative results may be obtained with a specified degree of confidence"(1). The recommended value for the limit of quantitation is 10 sigma. This is said to correspond "...to an uncertainty of +30% in the measured value (10 sigma±3 sigma) at the 99% confidence level"(1).

A value falling below 3 sigma is considered to be "not detected"; this is not to be interpreted as a zero level of concentration but merely below the sensitivity of the instrument. Values between 3 sigma and 10 sigma are considered to be in the "region of less-certain quantitation". Values greater than 10 sigma are considered to be in the region of quantitation. The ACS states quite emphatically that "...quantitative interpretation, decision making and regulatory actions should be limited to data at or above the limit of quantitation."

The above discussion is supplied as a source of information. More important, though, is that this program is designed to be a screening technique. In that light, the major emphasis should not be placed on individual samples but rather on the trend of analyte concentration over the area of interest.

(1) ACS Committee on Environmental Quality,"Principles of Environmental Analysis" Anal. Chem. 1983, 55, 2210-2218

The following values are from a site specific, low level blank (actual values in mg/kg: As=9.4, Cu=2.6, Cr=3.1) which was run in triplicate before and after every block of 10 routine samples. The Instrument Detection Limit (IDL) and the Limit of Quantitation (LOQ) are shown as 3 and 10 times the standard deviation (s) of the non-consecutive blanks.

All values are in mg/kg.

	X1			X2			X3		
	As	Cu	Cr	As	Cu	Cr	As	Cu	Cr
1.	18	0	28	22	2	0	33	24	0
2.	14	27	33	9	4	7	18	10	0
3.	13	0	1	7	0	17	8	0	9
4.	13	63	36	30	31	40	20	6	28
5.	20	62	7	9	4	19	0	3	11
6.	17	3	13	16	0	4	21	41	0
7.	14	29	20	27	0	31	0	0	11
8.	7	2	3	32	42	12	12	25	1
9.	33	59	0	17	0	0	25	24	27
10.	25	36	1	27	2	0	22	31	0
11.	24	37	27	19	2	18	4	6	0
12.	22	10	32	11	36	30	20	0	0
13.	14	67	31	4	12	0	27	33	0
14.	12	2	8	5	23	3	22	27	26
15.	25	40	22	21	52	0	15	32	0
16.	7	0	0	21	39	0	24	13	2
17.	16	6	11	15	48	7	17	0	1
18.	7	0	3	24	0	5	20	20	14
19.	16	11	12	24	8	1	21	18	0
20.	4	19	2	8	49	0	15	3	4
21.	17	27	22	27	50	6	6	0	36
22.	23	34	45	19	3	3	17	33	20
23.	8	11	9	23	44	0	1	13	9

	As	Cu	Cr
	n = 69	n = 69	n = 69
	x = 17	x = 20	x = 11
	s = 8	s = 19	s = 13
IDL	3s = 24	3s = 58	3s = 38
LOQ	10s = 81	10s = 193	10s = 125

Sheet G

Quality Control Check Samples

The following values are from a QCCS sample run in triplicate before and after every block of 10 routine samples. The true value in mg/kg is: As = 107.7, Cu = 106.2, Cr = 165.5.

All values are in mg/kg.

	X1			X2			X3		
	As	Cu	Cr	As	Cu	Cr	As	Cu	Cr
1.	103	54	37	96	0	48	88	73	49
2.	106	75	37	131	89	65	112	68	45
3.	103	33	61	94	71	46	101	106	52
4.	96	57	49	133	63	64	121	34	55
5.	103	41	58	109	71	52	122	49	55
6.	136	89	56	103	41	44	113	120	65
7.	130	95	65	119	67	56	104	61	56
8.	114	73	48	100	64	38	75	64	46
9.	78	37	38	110	62	58	90	29	42
10.	104	47	51	136	67	46	97	57	48
11.	103	52	49	98	26	48	116	35	57
12.	89	33	46	100	78	49	107	105	48
13.	57	75	49	97	85	46	77	86	39
14.	124	58	58	101	76	56	121	71	52
15.	85	57	40	118	118	59	117	52	48
16.	117	85	69	98	88	44	112	6	53
17.	116	11	55	120	85	61	90	72	51
18.	94	81	40	136	55	59	141	33	52
19.	95	14	41	107	92	56	116	69	46
20.	120	60	57	130	71	60	121	46	54
21.	114	59	70	119	48	63	117	95	47
22.	93	40	59	116	106	55	115	116	26

As	Cu	Cr
n = 66	n = 66	n = 66
x = 108	x = 64	x = 51
s = 16	s = 27	s = 9
%RSD = 15	%RSD = 42	%RSD = 17

Sheet H

Routine In Situ Analysis

The following are the composites (average values) of the triplicate analyses around each respective sample stake. The raw data are located in Appendix B.

****
Note that the majority of the data are below quantitation limits.
****

SAMPLE LOCATION	As	Cu	Cr
0W0N	32.0	6.0	53.0
0W100N	4.0	26.0	23.0
0W125N	12.0	29.0	73.0
0W150N	10.0	25.0	53.0
0W200N	55.0	38.0	41.0
0W250N	32.0	26.0	20.0
0W25N	25.0	26.0	50.0
0W300N	33.0	17.0	18.0
0W325N	53.0	28.0	40.0
0W350N	30.0	21.0	10.0
0W400N	21.0	25.0	30.0
0W450N	42.0	8.0	17.0
0W50N	3.0	15.0	41.0
0W75N	18.0	44.0	51.0
100W0N	0.0	27.0	86.0
100W100N	65.0	58.0	15.0
100W150N	85.0	108.0	35.0
100W200N	24.0	17.0	46.0
100W250N	29.0	35.0	58.0
100W25N	21.0	34.0	49.0
100W300N	38.0	46.0	39.0
100W325N	41.0	47.0	53.0
100W350N	223.0	84.0	26.0
100W400N	31.0	38.0	49.0
100W450N	24.0	45.0	28.0
100W50N	60.0	61.0	60.0
125W100N	37.0	0.0	10.0
125W125N	32.0	27.0	29.0
125W150N	30.0	32.0	10.0
125W175N	55.0	34.0	33.0
125W25N	16.0	57.0	54.0
125W50N	24.0	129.0	23.0
125W75N	38.0	37.0	47.0
150N-25W	80.0	44.0	68.0
150W0N	0.0	32.0	42.0
150W100N	30.0	28.0	33.0
150W150N	16.0	21.0	35.0
150W200N	7.0	20.0	7.0

150W250N	35.0	53.0	9.0
150W25N	3.0	1.0	52.0
150W300N	30.0	12.0	12.0
150W350N	24.0	41.0	23.0
150W400N	42.0	8.0	6.0
150W450N	22.0	12.0	29.0
150W50N	11.0	4.0	52.0
175N-25W	0.0	36.0	126.0
200N-25W	64.0	85.0	23.0
200W0N	4.0	21.0	62.0
200W400N	4.0	31.0	35.0
200W450N	7.0	23.0	2.0
200W500N	10.0	24.0	7.0
225N-25W	28.0	36.0	21.0
250W0N	16.0	25.0	40.0
250W450N	26.0	56.0	45.0
250W500N	9.0	22.0	19.0
250W650N	10.0	8.0	39.0
25W100N	37.0	46.0	36.0
25W125N	39.0	18.0	31.0
25W150N	44.0	48.0	35.0
25W25N	38.0	75.0	67.0
25W50N	18.0	55.0	60.0
25W75N	49.0	26.0	35.0
300W0N	84.0	5.0	27.0
300W100N	33.0	34.0	37.0
300W250N	25.0	42.0	30.0
300W450N	51.0	32.0	21.0
300W475N	1.0	5.0	2.0
300W500N	0.0	42.0	19.0
300W50N	28.0	16.0	29.0
300W650N	7.0	12.0	6.0
350W0N	8.0	11.0	25.0
350W250N	41.0	45.0	34.0
350W300N	33.0	26.0	44.0
350W350N	39.0	34.0	38.0
350W400N	73.0	40.0	30.0
350W475N	52.0	77.0	72.0
350W500N	0.0	34.0	17.0
400W0N	18.0	39.0	8.0
400W100N	26.0	77.0	11.0
400W150N	7.0	40.0	1.0
400W200N	17.0	50.0	14.0
400W250N	36.0	24.0	21.0
400W300N	34.0	58.0	65.0
400W475N	376.0	160.0	0.0
400W500N	9.0	45.0	6.0
400W50N	17.0	77.0	65.0
400W700N	20.0	5.0	26.0
400W750N	0.0	14.0	38.0
425W500N	6.0	49.0	5.0
425W550N	1.0	11.0	3.0
450W0N	0.0	25.0	7.0
450W1000N	8.0	28.0	22.0

450W300N	16.0	0.0	46.0
450W550N	22.0	19.0	3.0
450W600N	0.0	22.0	18.0
450W650N	11.0	14.0	7.0
450W700N	7.0	23.0	16.0
450W750N	5.0	17.0	6.0
450W850N	10.0	14.0	18.0
450W900N	16.0	8.0	19.0
450W950N	20.0	6.0	11.0
500W0N	6.0	15.0	12.0
500W1000N	0.0	15.0	41.0
500W100N	0.0	23.0	2.0
500W150N	0.0	10.0	6.0
500W200N	7.0	32.0	1.0
500W250N	37.0	16.0	31.0
500W300N	30.0	26.0	50.0
500W350N	28.0	65.0	65.0
500W400N	15.0	31.0	18.0
500W450N	49.0	56.0	40.0
500W500N	7.0	26.0	8.0
500W50N	7.0	12.0	8.0
500W550N	2.0	28.0	18.0
500W600N	2.0	13.0	15.0
500W650N	4.0	7.0	9.0
500W700N	1.0	13.0	39.0
500W750N	9.0	18.0	62.0
500W800N	3.0	42.0	47.0
500W850N	23.0	75.0	45.0
500W900N	10.0	18.0	0.0
500W950N	2.0	23.0	2.0
50W100N	36.0	41.0	59.0
50W125N	30.0	64.0	49.0
50W25N	13.0	24.0	58.0
50W275N	62.0	60.0	41.0
50W300N	62.0	64.0	24.0
50W325N	40.0	11.0	32.0
50W450N	36.0	53.0	56.0
50W50N	157.0	110.0	23.0
550W0N	12.0	34.0	10.0
550W1000N	18.0	23.0	6.0
550W1050N	3.0	26.0	54.0
550W250N	16.0	40.0	10.0
550W300N	17.0	54.0	21.0
550W400N	15.0	26.0	46.0
550W450N	3.0	30.0	4.0
550W500N	20.0	42.0	28.0
550W525N	17.0	42.0	1.0
550W550N	7.0	22.0	10.0
550W600N	0.0	29.0	0.0
550W650N	0.0	17.0	4.0
550W700N	2.0	11.0	7.0
550W750N	1.0	13.0	27.0
550W800N	5.0	6.0	21.0
550W850N	6.0	4.0	0.0

550W900N	3.0	12.0	36.0
550W950N	5.0	25.0	22.0
575W1000N	4.0	16.0	16.0
575W1050N	1.0	36.0	55.0
575W550N	1.0	15.0	3.0
575W600N	0.0	35.0	10.0
575W650N	0.0	19.0	28.0
600W0N	18.0	41.0	19.0
600W200N	31.0	35.0	39.0
600W350N	24.0	34.0	31.0
650W500N	8.0	12.0	3.0
75W100N	23.0	39.0	16.0
75W125N	139.0	123.0	22.0
75W150N	55.0	84.0	39.0
75W175N	47.0	40.0	61.0
75W200N	62.0	80.0	56.0
75W225N	46.0	54.0	30.0
75W250N	57.0	106.0	59.0
75W25N	0.0	41.0	71.0
75W275N	63.0	114.0	30.0
75W300N	68.0	69.0	26.0
75W325N	30.0	22.0	22.0
75W50N	123.0	58.0	43.0

Sheet I

Sampling and Sample Grid

No physical samples were taken. All analyses were in situ. No in situ homogenization sampling was performed.

Distance between sample stations: 50 ft

A sampling grid of 50 foot intervals was laid out over the entire site in map view. Many of the grid nodes were inaccessible as they fell within an existing structure or beneath a concrete pad. Sampling was also done on 25 foot intervals between grid nodes where possible or deemed necessary.

Appearance of soil: Wet or dry

Description of soil: The central portion of the site (that area over which there is the most travel) is covered with import base rock. The natural soil is mostly a silty sand.

Analyses made prior to sampling? Y N. If yes, reference the sample numbers and analyses: _____

Sheet J

Concentration Isopleth Contouring

Spatial Structure Analysis

Data analysis was limited to arsenic because it is of primary concern at the Saunders site. Triplicate data values obtained at each sample location were averaged to provide 169 composite values for arsenic. Many of the composite values are less than 25 ppm which represents the instrument detection limit and were therefore excluded to leave 70 values available for spatial analysis. The retained values are limited to the southern portion of the site, thus limiting the geographic area included in spatial analysis and mapping. Following are descriptive statistics for the retained values.

mean:	54.7 ppm
standard deviation:	50.7 ppm
coeff. variation:	0.927
skewness:	4.440

A strong positive skewness is shown by the histogram and probability plots. However, the coeff. of variation is well below the value of 2.0 generally recommended for logtransformation, so spatial analysis was performed on untransformed data.

Semivariograms were generated for several different directions using distance increments of 57 feet and angular tolerance of 45 degrees. The only coherent structure was obtained in the north-south direction, probably due to the sparseness and clustered distribution of sample locations in the other directions. Parameters were therefore estimated for an isotropic spatial model based on the north-south semivariogram.

Spatial Interpolation

Availability of a variogram model permitted employment of kriging for interpolation of a spatial model of composite arsenic concentrations. Ordinary kriging was first employed to obtain an estimate of the global mean for the retained sample area. The resulting value - 52.3 ppm - was then used in simple kriging for local estimation over the sample area to produce a spatial grid model with ten feet between grid nodes. Isopleths for selected levels of concentration were interpolated through the grid model and appear as contour lines on the kriging map. Parameters utilized for the kriging interpolation appear below.

Search Constraints

search neighborhood:	circular
search radius:	150 feet
minimum number of samples:	4
maximum number of samples:	24
number of search sectors:	1
number of empty sectors allowed:	0

Grid Model

grid x-origin:	0.0 feet east
grid y-origin:	0.0 feet north
grid x-spacing:	10 feet
grid y-spacing:	10 feet
number of nodes in x-direction:	76
number of nodes in y-direction:	56

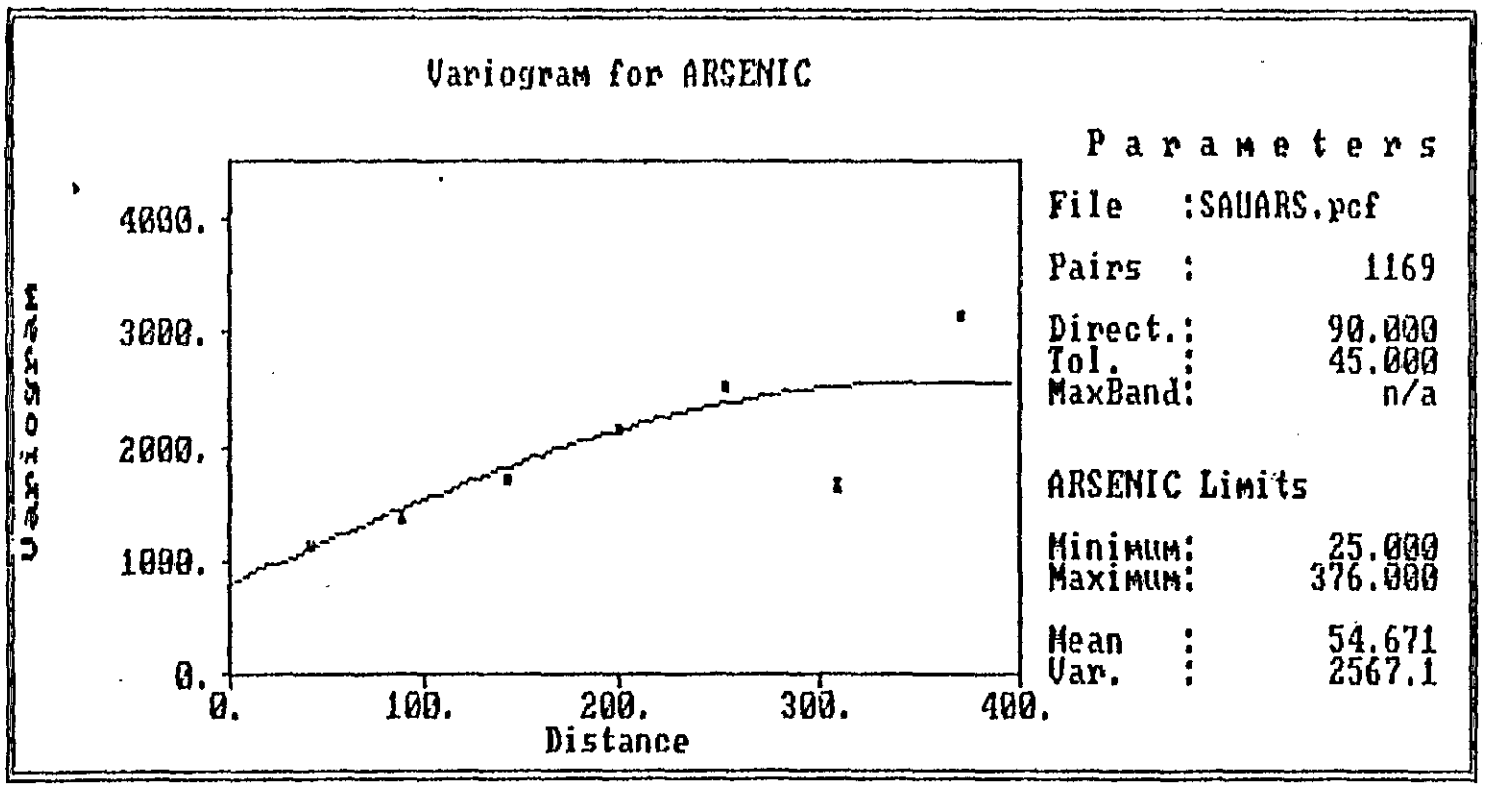
Variogram Model

sill:	2567 ppm-squared
nugget variance:	800 ppm-squared
range:	350 feet
anisotropy:	none
model:	spherical

Kriging

kriging type:	simple
global mean:	52.3 ppm

The reader should be aware that some of the contour lines traverse unsampled areas covered by buildings and concrete pads, implying continuity in the factors that govern the transport and deposition of arsenic that is probably unrealistic in such areas. Interpretation of the contour lines should also proceed with recognition that each contour is banded with a margin of error. Some idea of the magnitude of error can be obtained from the kriging error map. This map can also be used to optimize the design of future sampling in this portion of the site area. The most cost-effective samples should be taken where the kriging error is greatest.


Variogram for ARSENIC
Variogram
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3000.
2000.
1000.
0.
0.
100.
200.
300.
400.
Distance
Parameters
File :SAUARS.pcf
Pairs : 1169
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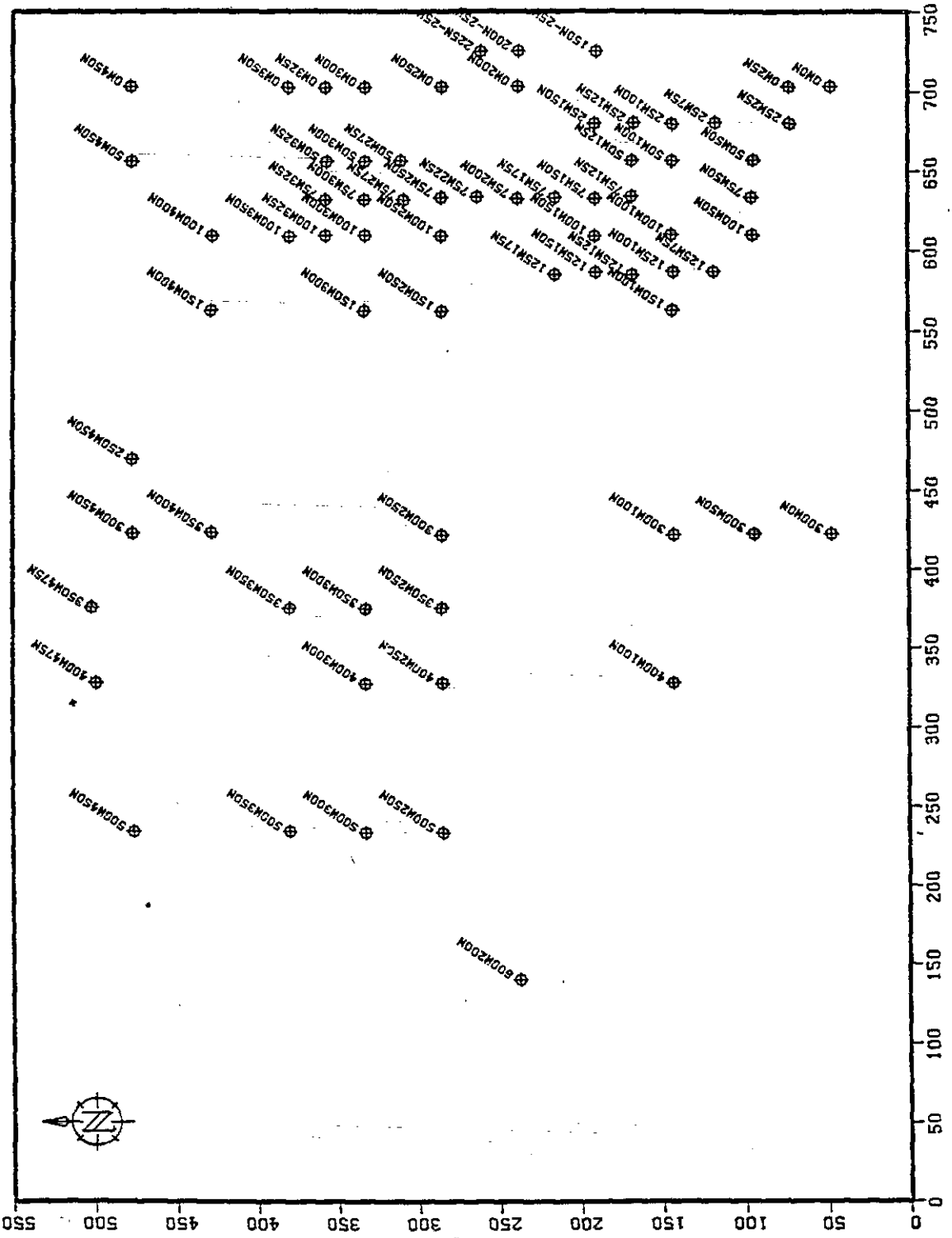
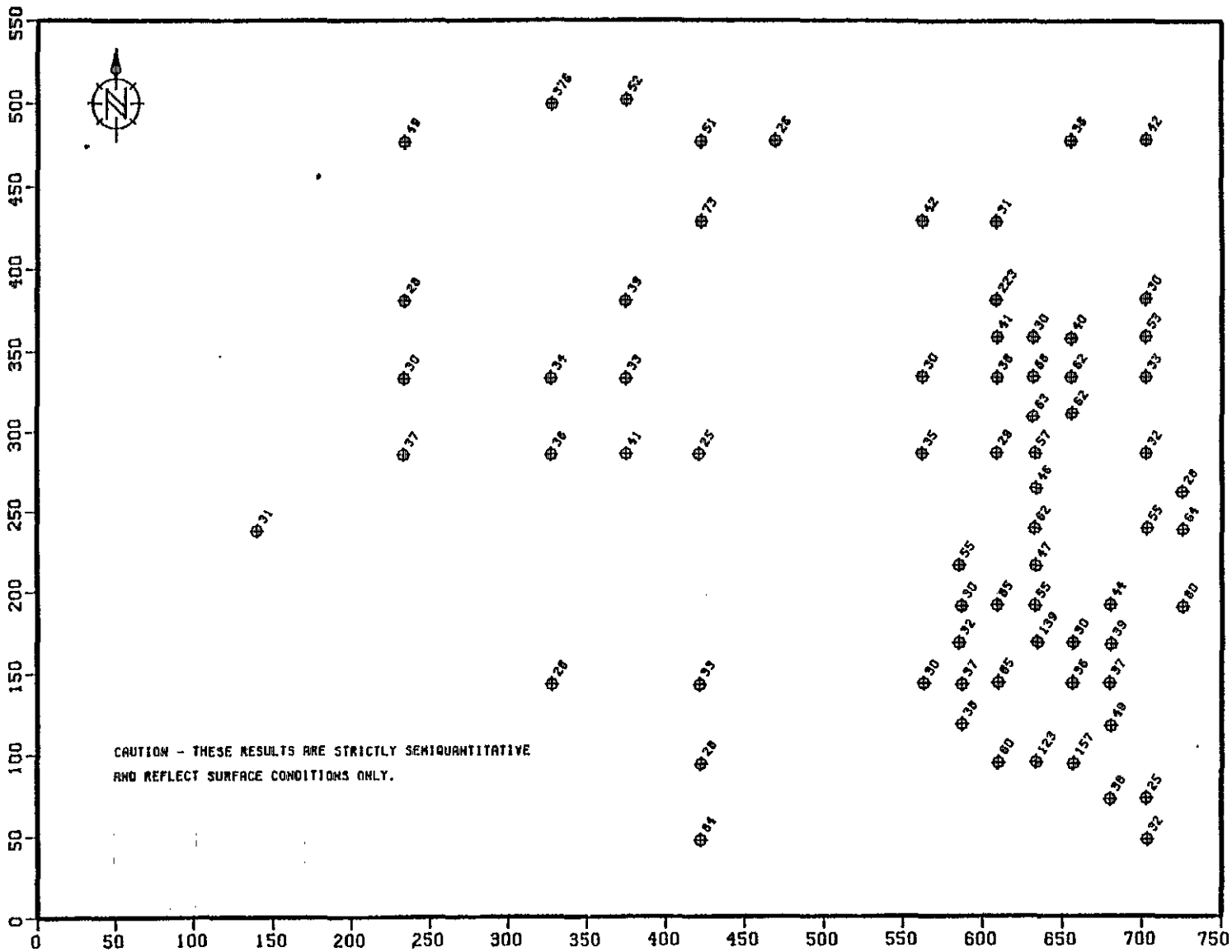
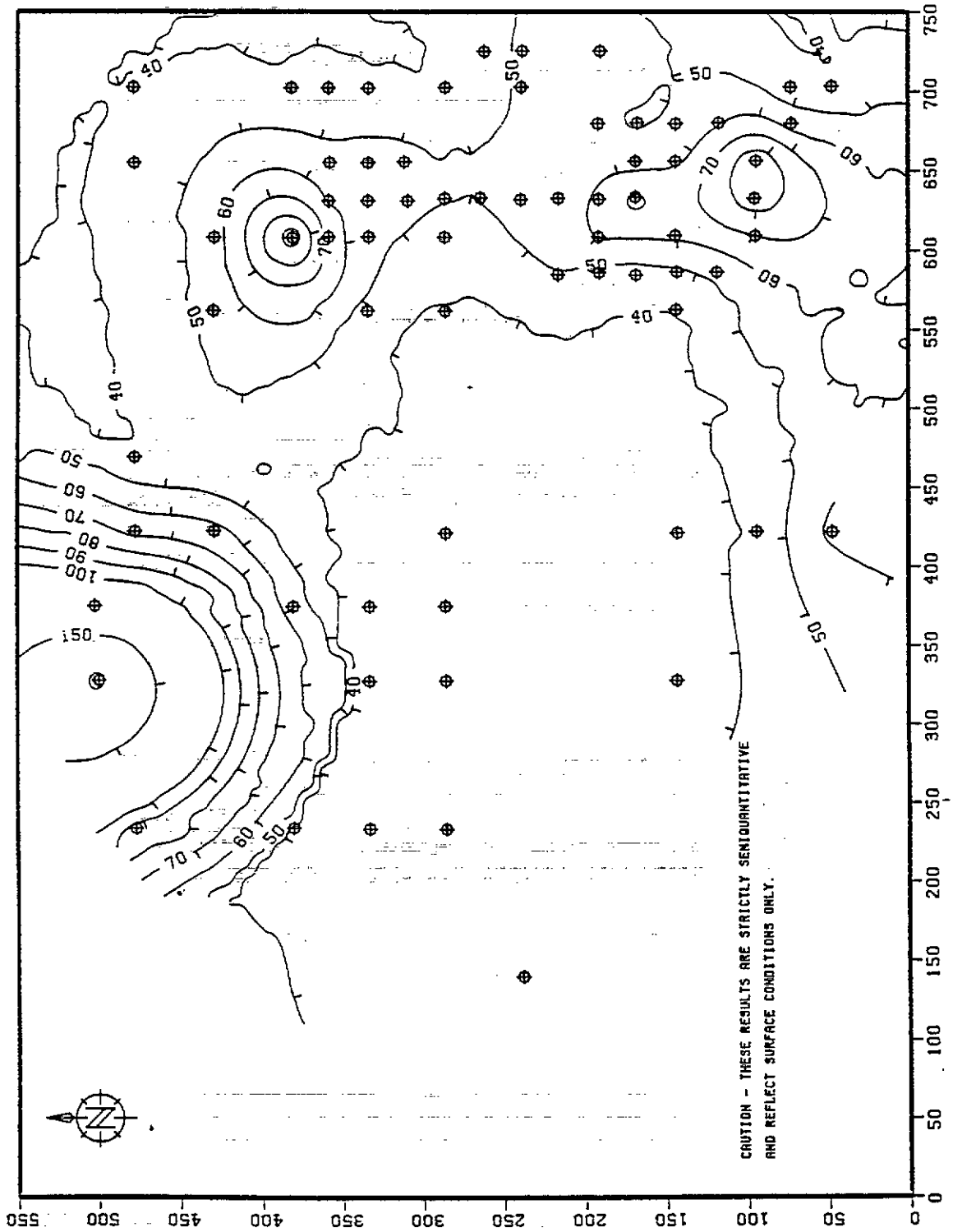
Tol. : 45.000
MaxBand: n/a
ARSENIC Limits
Minimum: 25.000
Maximum: 376.000
Mean : 54.671
Var. : 2567.1



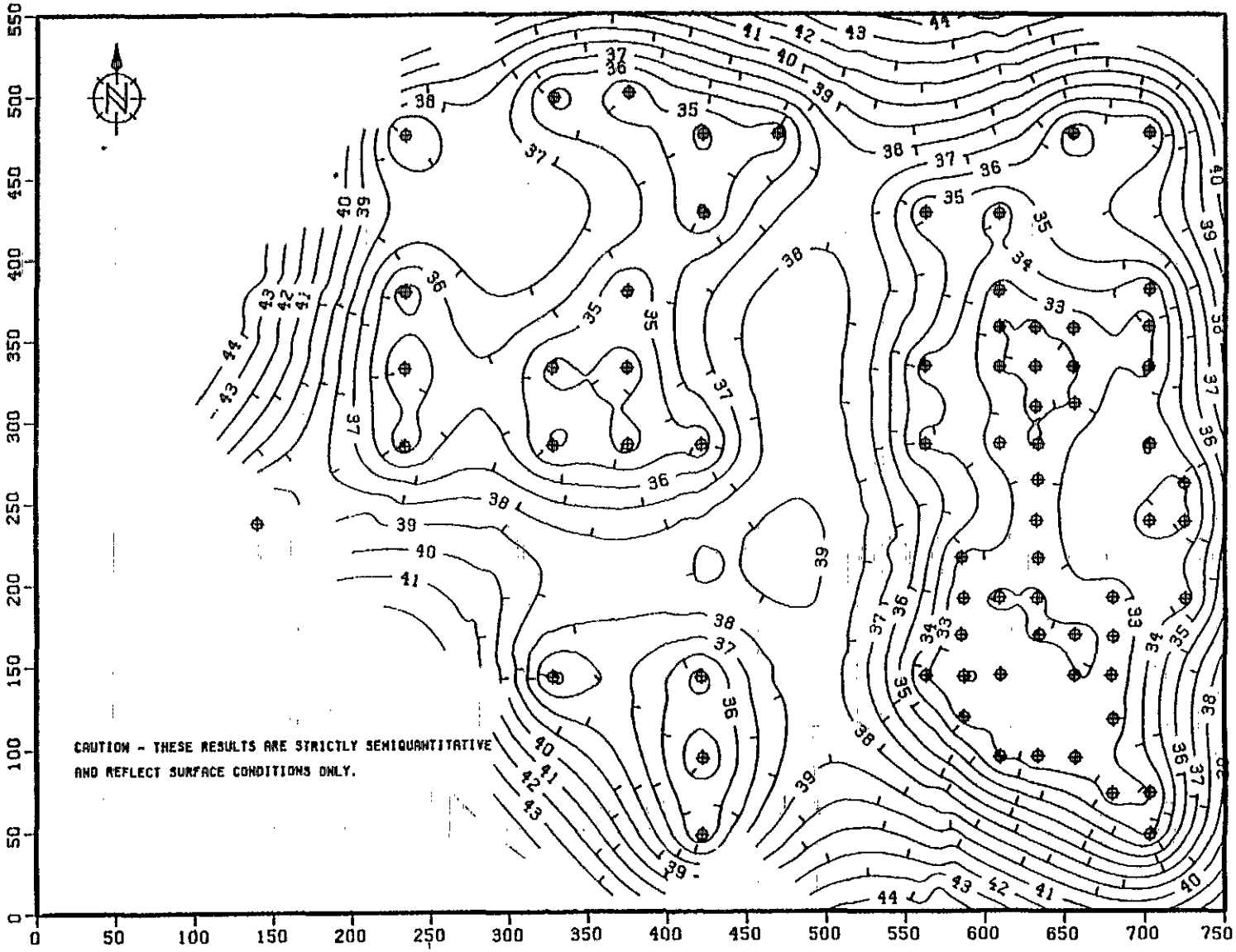
SAUNDERS SUPPLY CORP. SITE
XRF SAMPLE LOCATIONS AND ID NUMBERS



SAUNDERS SUPPLY CORP. SITE
XRF SAMPLE LOCATIONS
ARSENIC CONCENTRATIONS ABOVE INSTRUMENT DETECTION LIMITS
ALL VALUES IN PPM ARSENIC



SAUNDERS SUPPLY CORP. SITE
ARSENIC CONTOURS - KRIGING INTERPOLATOR
CONTOUR VALUES IN PPM ARSENIC
CONTOUR LEVELS - 40, 50, 60, 70, 80, 90, 100, 150, 200 PPM

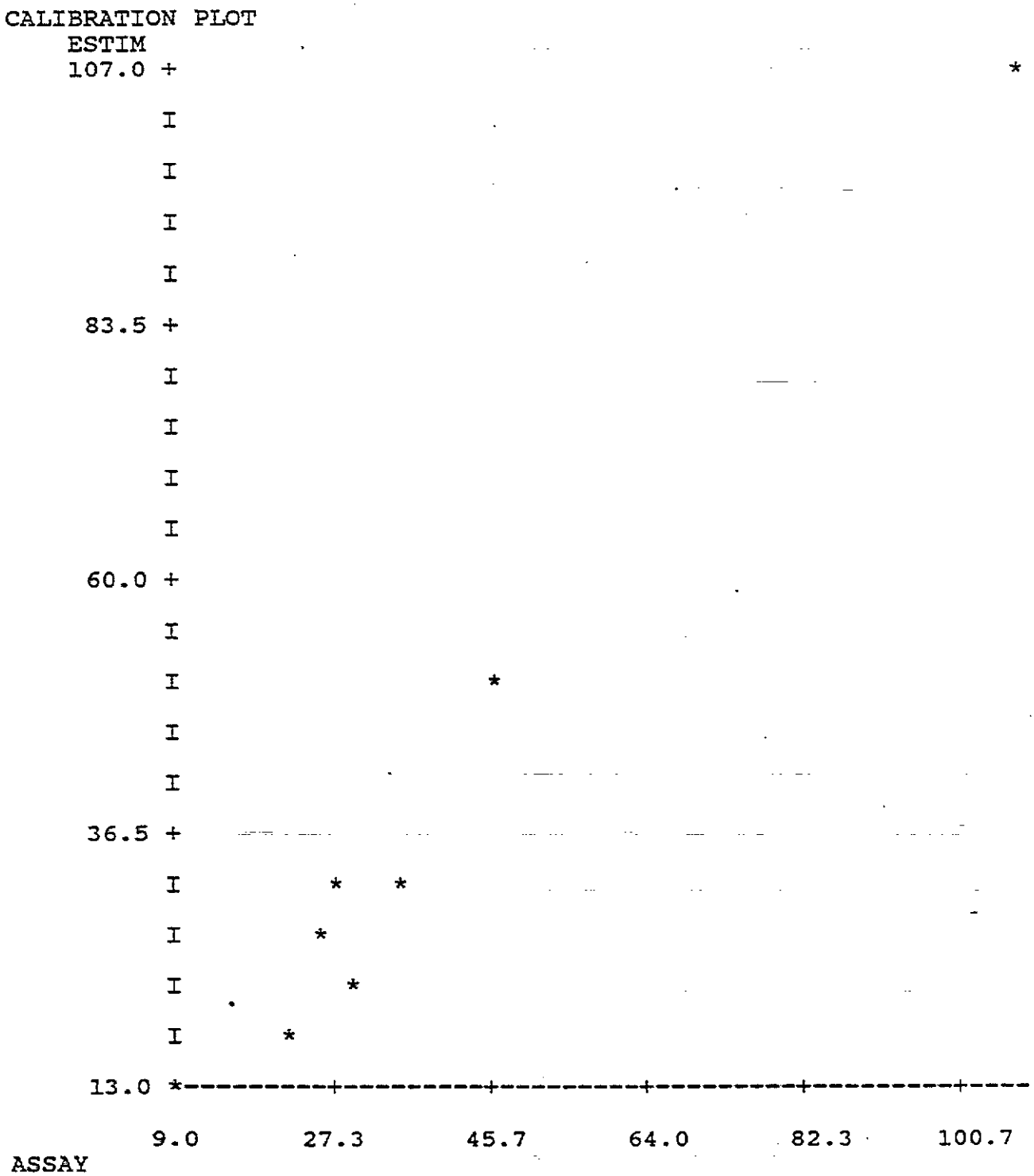


SAUNDERS SUPPLY CORP. SITE
INTERPOLATION ERROR CONTOURS
KRIGING STANDARD DEVIATION IN PPM ARSENIC
CONTOUR LEVELS - 32 TO 44 BY 1 PPM

Appendix A

XMET Modeling Information

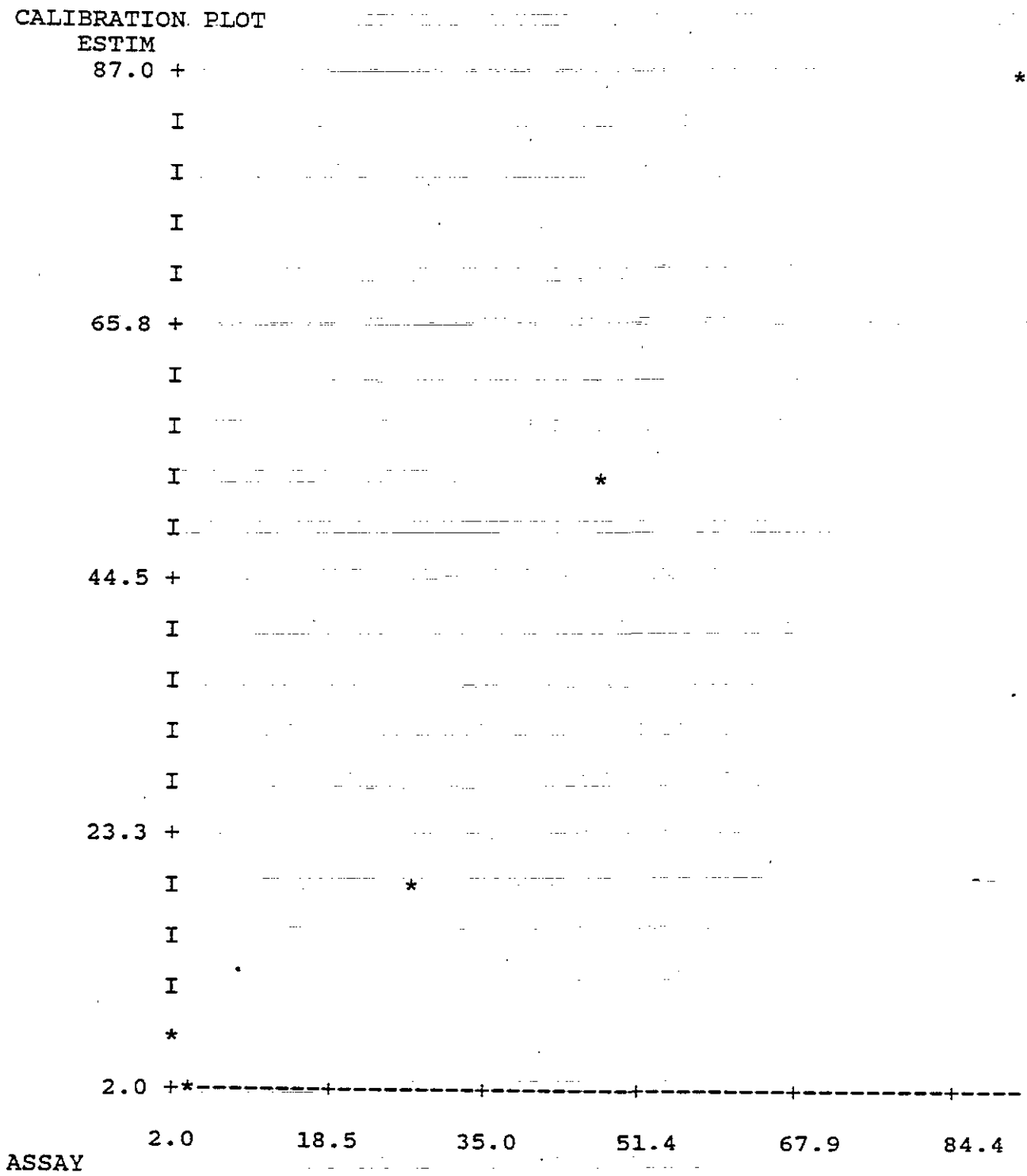
```
***====================REGRESSION FOR AS====================***

DEFINE INDEPENDENTS:
Stop indep input by END-key
1. indep: AS?
2. indep: AS*PB?
3. indep:  ?

R= 0.969 S= 8.344 F(2,6)=   45.7
----------------------------------

RESIDUALS?

CALIBRATION FIT
NO. ASSAY  ESTIM.  RESID. ST.RES.
 1  9.400 11.813  -2.413  -0.289
 2 45.100 51.832  -6.732  -0.807
 3 33.900 36.676  -2.776  -0.333
 4  107.7  107.9  -0.243  -0.029
 5 25.800 30.251  -4.451  -0.533
 6 60.100 43.891  16.209   1.943
 7 27.200 34.136  -6.936  -0.831
 8 22.500 19.594   2.906   0.348
 9 28.900 24.463   4.437   0.532

DELETE POINTS: 6

R= 0.994 S= 4.011 F(2,5)=  194.2
----------------------------------

RESIDUALS?

CALIBRATION FIT
NO. ASSAY  ESTIM.  RESID. ST.RES.
 1  9.400 13.076  -3.676  -0.916
 2 45.100 48.993  -3.893  -0.970
 3 33.900 30.604   3.296   0.822
 4  107.7  106.9   0.844   0.210
 5 25.800 27.629  -1.829  -0.456
 6 27.200 29.688  -2.488  -0.620
 7 22.500 19.207   3.293   0.821
 8 28.900 24.448   4.452   1.110
d
```



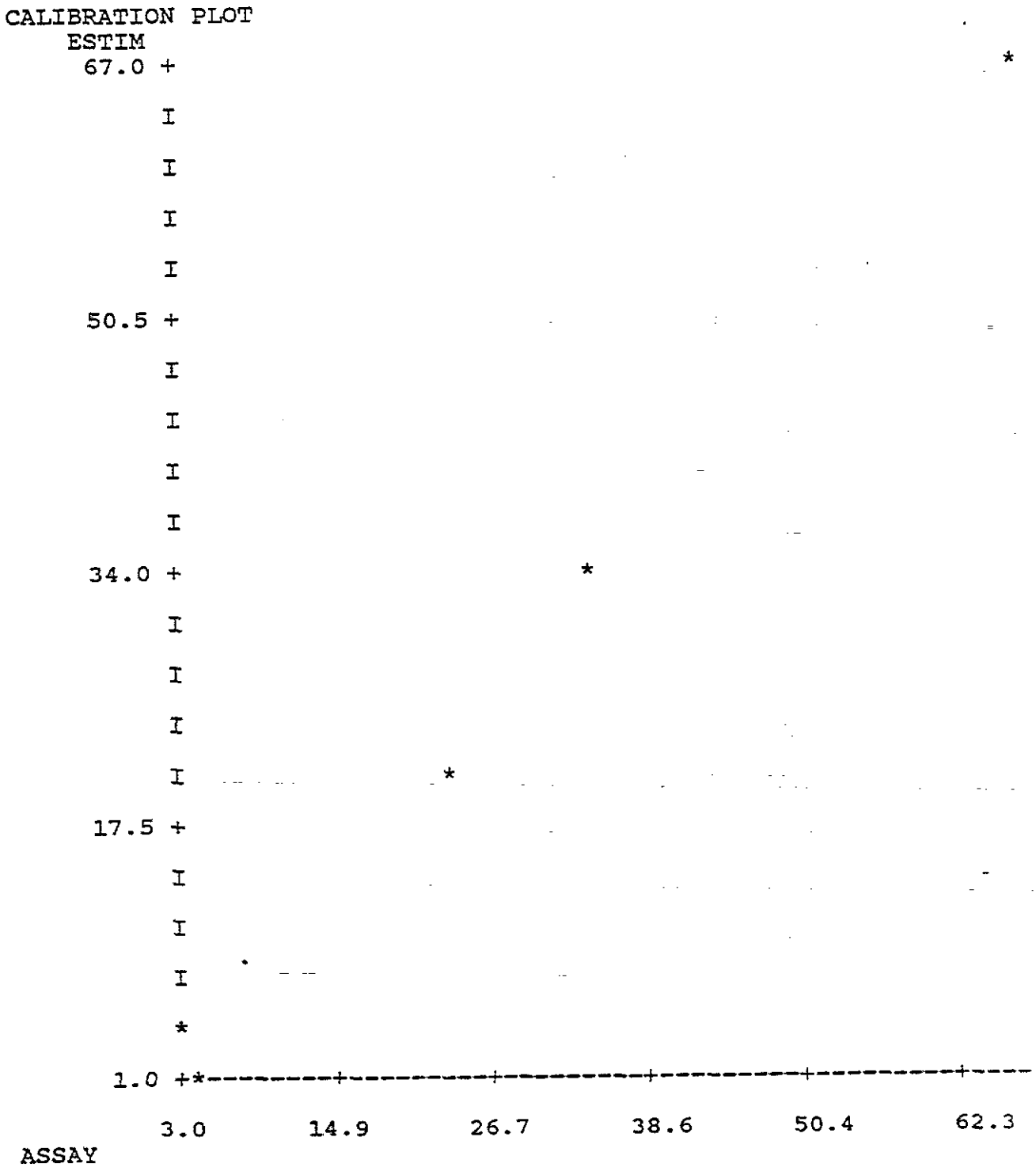
COEFFICIENTS AND T-VALUES?
INTERCEPT= -2.8340911E+2
SLOPE 1=4.939344E0 T= 16.58
SLOPE 2=2.392495E-2 T= 19.31

```
***==============REGRESSION FOR CU====================***

DEFINE INDEPENDENTS:
Stop indep input by END-key
1. indep: CU/?
2. indep:  ?

R= 0.470 S= 62.22 F(1,7)=    2.0
-----------------------------------

RESIDUALS?

CALIBRATION FIT
NO. ASSAY  ESTIM.  RESID. ST.RES.
 1  2.600 27.497 -24.897  -0.400
 2 50.500 55.671  -5.171  -0.083
 3 13.600 51.430 -37.830  -0.608
 4  106.2 86.531  19.669   0.316
 5 46.500 82.854 -36.354  -0.584
 6 90.400  119.9 -29.524  -0.475
 7  207.7 59.823   147.9   2.377
 8  4.300 22.286 -17.986  -0.289
 9 27.100 42.884 -15.784  -0.254

DELETE POINTS: 2 3 4 7

R= 0.986 S= 7.088 F(1,3)=  101.6
-----------------------------------

RESIDUALS?

CALIBRATION FIT
NO. ASSAY  ESTIM.  RESID. ST.RES.
 1  2.600  6.977  -4.377  -0.617
 2 46.500 54.644  -8.144  -1.149
 3 90.400 86.565   3.835   0.541
 4  4.300  2.489   1.811   0.255
 5 27.100 20.226   6.874   0.970
d
```

```
***======================REGRESSION FOR CR=========================***

CHANGE INDEPENDENTS?
Stop indep input by END-key
1. indep: CR?
2. indep: CR*FE?
3. indep:  ?

R= 0.635 S= 46.34 F(2,6)=    2.0
---------------------------------

RESIDUALS?

CALIBRATION FIT
NO. ASSAY  ESTIM.  RESID. ST.RES.
 1  3.100 14.411 -11.311  -0.244
 2 33.400 58.341 -24.941  -0.538
 3 23.100 43.930 -20.830  -0.449
 4  165.5 80.030  85.470   1.844
 5 90.200 85.986   4.214   0.091
 6 66.800 89.785 -22.985  -0.496
 7 18.200 64.054 -45.854  -0.989
 8  3.600  8.853  -5.253  -0.113
 9 50.600  9.110  41.490   0.895

DELETE POINTS: 4 5 7 9

R= 0.997 S= 2.695 F(2,2)=  188.6
---------------------------------

RESIDUALS?

CALIBRATION FIT
NO. ASSAY  ESTIM.  RESID. ST.RES.
 1  3.100  5.666  -2.566  -0.952
 2 33.400 34.626  -1.226  -0.455
 3 23.100 21.992   1.108   0.411
 4 66.800 66.354   0.446   0.165
 5  3.600  1.362   2.238   0.831
d
```



DELETE POINTS:
COEFFICIENTS AND T-VALUES?
INTERCEPT= 1.5431094E+2
SLOPE 1=4.3788164E+3 T= 10.08



DELETE POINTS:
COEFFICIENTS AND T-VALUES?
INTERCEPT= 6.6286193E+1
SLOPE 1=-3.994315E0 T=-18.89
SLOPE 2=5.796753E-3 T= 9.74

Appendix B

Raw Data From Screening In Situ

SAMPLE NUMBER	Cu	As	Cr
0W0N	7.718	30.34	51.45
0W0N	0.0	23.17	42.94
0W0N	10.42	42.94	63.53
0W100N	71.16	0.0	27.37
0W100N	4.409	10.30	0.430
0W100N	1.679	3.089	40.75
0W125N	31.24	11.67	77.84
0W125N	4.261	20.68	64.93
0W125N	50.06	4.839	74.80
0W150N	15.44	0.0	65.32
0W150N	0.0	3.040	34.47
0W150N	59.20	26.70	60.54
0W200N	60.70	41.51	53.47
0W200N	18.28	78.07	22.05
0W200N	34.94	44.82	48.40
0W250N	0.0	27.90	2.126
0W250N	13.63	38.68	13.86
0W250N	64.03	29.16	45.39
0W25N	0.0	14.14	58.28
0W25N	24.23	44.13	26.94
0W25N	54.29	16.84	64.37
0W300N	49.48	21.88	28.13
0W300N	1.713	58.35	0.0
0W300N	0.0	20.13	24.95
0W325N	36.24	33.11	38.74
0W325N	19.40	65.99	39.40
0W325N	27.17	60.34	42.14
0W350N	58.79	14.53	30.99
0W350N	0.0	36.96	0.0
0W350N	3.859	38.38	0.0
0W400N	0.0	9.995	0.0
0W400N	45.80	20.55	37.44
0W400N	27.86	32.47	52.68
0W450N	6.680	34.13	30.19
0W450N	16.01	50.05	21.51
0W450N	0.404	42.42	0.0
0W50N	6.939	0.794	46.25
0W50N	8.622	0.0	32.87
0W50N	30.42	6.832	44.07
0W75N	53.16	0.0	83.74
0W75N	40.85	33.29	13.21
0W75N	37.43	21.80	54.85
100W0N	0.0	0.255	66.82
100W0N	28.94	0.0	113.0
100W0N	52.93	0.0	77.81
100W100N	51.77	106.4	0.0
100W100N	38.75	21.85	44.44

100W100N	82.45	67.09	0.0
100W150N	63.88	82.33	57.01
100W150N	88.46	69.86	20.92
100W150N	172.2	102.2	27.46
100W200N	11.58	35.59	47.05
100W200N	26.32	17.22	49.01
100W200N	13.21	19.39	43.18
100W250N	38.42	34.40	46.40
100W250N	23.18	18.46	74.02
100W250N	44.24	35.20	54.96
100W25N	30.16	25.43	47.57
100W25N	34.81	7.346	35.10
100W25N	37.49	29.01	64.01
100W300N	55.50	46.59	54.49
100W300N	24.82	35.42	21.52
100W300N	57.61	31.62	42.33
100W325N	83.58	66.99	50.30
100W325N	35.68	22.84	57.25
100W325N	21.59	32.46	50.10
100W350N	36.79	45.52	53.33
100W350N	134.3	576.7	0.0
100W350N	80.67	45.60	24.35
100W400N	0.0	0.0	55.28
100W400N	72.08	56.18	62.86
100W400N	42.96	37.44	28.38
100W450N	75.01	28.14	21.33
100W450N	0.0	38.54	31.18
100W450N	60.39	3.990	31.88
100W50N	36.35	70.75	62.85
100W50N	87.31	43.67	42.64
100W50N	59.79	66.76	75.75
125W100N	0.0	42.56	10.17
125W100N	0.0	28.92	2.144
125W100N	1.152	38.97	18.13
125W125N	31.45	42.87	37.91
125W125N	20.36	22.10	24.55
125W125N	27.84	30.77	24.21
125W150N	49.82	24.10	0.0
125W150N	26.94	25.65	8.936
125W150N	20.15	41.14	20.75
125W175N	24.12	39.87	31.95
125W175N	9.013	67.03	41.76
125W175N	68.79	59.51	24.57
125W25N	25.35	11.55	40.64
125W25N	109.0	21.04	79.75
125W25N	37.74	15.76	41.68
125W50N	125.5	0.0	0.0
125W50N	85.85	40.42	60.75
125W50N	174.3	32.14	6.893
125W75N	0.0	34.84	50.14
125W75N	51.45	50.84	52.29
125W75N	61.01	28.45	38.34
150N-25W	73.82	52.55	79.72
150N-25W	10.95	80.67	63.85

150N-25W	48.55	106.9	59.39
150W0N	23.29	0.0	64.26
150W0N	28.35	0.0	34.80
150W0N	44.86	0.0	26.18
150W100N	45.91	27.95	40.31
150W100N	0.0	35.32	23.85
150W100N	36.98	27.77	33.79
150W150N	0.0	1.746	0.0
150W150N	1.753	0.0	61.30
150W150N	61.96	45.13	43.38
150W200N	46.32	15.57	4.115
150W200N	0.0	0.0	1.760
150W200N	13.19	6.140	15.96
150W250N	95.07	49.41	0.0
150W250N	23.40	26.55	0.0
150W250N	40.96	29.16	25.86
150W25N	0.0	0.0	70.01
150W25N	0.0	5.081	28.80
150W25N	4.161	5.166	57.30
150W300N	0.0	24.74	0.0
150W300N	35.21	27.08	25.26
150W300N	0.0	38.30	10.60
150W350N	60.93	13.28	26.68
150W350N	12.92	38.40	0.0
150W350N	49.16	20.25	42.95
150W400N	5.751	41.24	12.05
150W400N	6.396	34.41	2.063
150W400N	11.62	51.68	4.830
150W450N	0.0	0.0	33.29
150W450N	4.979	37.87	15.22
150W450N	29.62	28.51	39.01
150W50N	0.0	1.658	63.56
150W50N	0.0	0.0	54.77
150W50N	11.68	32.45	36.73
175N-25W	50.76	0.0	109.3
175N-25W	4.476	0.0	120.5
175N-25W	51.75	0.0	148.9
200N-25W	135.5	116.6	0.0
200N-25W	74.42	28.22	49.66
200N-25W	46.26	47.34	19.53
200W0N	5.111	6.671	60.72
200W0N	23.81	4.116	53.64
200W0N	34.42	0.0	71.69
200W400N	42.71	0.0	32.68
200W400N	0.0	9.605	62.16
200W400N	50.24	1.958	9.485
200W450N	0.0	21.10	0.0
200W450N	21.12	0.0	0.0
200W450N	47.11	0.0	7.376
200W500N	24.08	0.0	11.98
200W500N	0.0	17.53	0.0
200W500N	48.41	12.75	7.522
225N-25W	67.73	31.87	23.57
225N-25W	39.21	25.84	38.13

225N-25W	0.0	27.74	0.0
250W0N	8.226	13.16	35.26
250W0N	63.16	30.92	31.06
250W0N	5.057	3.229	53.51
250W450N	61.35	22.87	49.42
250W450N	43.96	29.96	49.58
250W450N	62.35	24.33	37.48
250W500N	37.64	0.0	13.74
250W500N	20.95	12.95	26.72
250W500N	7.370	13.90	16.51
250W650N	2.771	25.32	13.49
250W650N	22.22	0.0	43.22
250W650N	0.0	3.444	61.20
25W50N	77.59	12.26	64.81
25W50N	45.70	0.0	62.15
25W50N	42.02	41.37	52.06
25W100N	24.27	18.79	26.83
25W100N	47.67	39.60	31.32
25W100N	67.46	51.55	48.74
25W125N	23.66	14.92	45.96
25W125N	21.78	29.21	40.22
25W125N	9.208	73.02	8.071
25W150N	30.34	44.72	31.98
25W150N	33.43	36.88	42.97
25W150N	78.97	50.56	29.90
25W75N	0.0	39.78	58.94
25W75N	43.29	65.72	27.55
25W75N	34.07	41.40	18.85
25W25N	98.20	40.98	65.70
25W25N	68.12	40.48	71.85
25W25N	59.09	33.07	63.28
300W0N	14.82	31.16	22.65
300W0N	0.0	92.57	32.21
300W0N	0.0	128.1	24.64
300W100N	48.84	24.81	39.65
300W100N	47.68	32.32	48.92
300W100N	4.205	40.92	23.17
300W250N	54.19	38.89	41.54
300W250N	32.86	10.74	21.42
300W250N	38.54	26.37	26.31
300W450N	62.51	23.59	12.79
300W450N	32.61	64.53	49.32
300W450N	0.0	63.81	0.0
300W475N	14.12	0.0	5.033
300W475N	0.0	2.432	0.0
300W475N	0.0	0.0	0.0
300W500N	33.85	0.0	31.37
300W500N	69.51	0.0	13.63
300W500N	22.29	0.0	12.48
300W50N	16.07	20.06	31.08
300W50N	31.73	33.62	28.22
300W50N	0.296	31.37	28.20
300W650N	0.0	21.07	4.221
300W650N	31.03	0.0	12.65

300W650N	5.244	0.0	0.0
350W0N	25.10	13.82	18.60
350W0N	1.047	9.736	24.19
350W0N	7.236	0.0	32.47
350W250N	74.57	37.59	27.51
350W250N	15.56	29.06	33.90
350W250N	46.18	57.46	41.04
350W300N	0.0	34.63	37.72
350W300N	56.17	23.01	43.17
350W300N	21.91	40.76	51.87
350W350N	35.79	34.30	34.51
350W350N	50.63	24.18	37.93
350W350N	16.61	59.44	40.89
350W400N	55.68	57.55	24.02
350W400N	51.32	101.6	38.67
350W400N	13.99	59.75	28.31
350W475N	121.8	50.10	69.08
350W475N	110.1	74.69	70.29
350W475N	0.321	31.30	76.14
350W500N	28.90	0.0	5.313
350W500N	55.98	0.0	14.88
350W500N	17.26	0.0	31.98
400W0N	54.33	0.0	6.685
400W0N	33.13	32.38	18.50
400W0N	30.60	21.55	0.0
400W100N	45.69	14.27	14.34
400W100N	127.6	26.43	20.06
400W100N	56.23	38.52	0.0
400W150N	13.53	0.0	4.129
400W150N	32.64	10.69	0.0
400W150N	74.17	8.984	0.0
400W200N	57.96	37.12	33.11
400W200N	58.97	6.201	0.0
400W200N	33.59	7.432	8.184
400W250N	26.27	37.47	26.59
400W250N	28.61	20.18	28.19
400W250N	16.27	51.36	7.699
400W300N	47.75	46.32	73.70
400W300N	96.89	20.21	67.69
400W300N	29.82	36.48	53.78
400W475N	251.4	672.1	0.0
400W475N	141.8	259.4	0.0
400W475N	86.93	195.3	0.0
400W500N	40.51	22.60	0.0
400W500N	81.69	4.204	19.01
400W500N	12.97	0.0	0.0
400W50N	87.26	16.85	61.18
400W50N	76.78	0.0	69.74
400W50N	67.72	35.25	63.25
400W700N	15.41	33.24	23.15
400W700N	0.0	7.126	17.09
400W700N	0.0	18.97	36.74
400W750N	16.29	0.0	8.257
400W750N	21.36	0.0	69.05

400W750N	4.343	1.140	35.59
425W500N	65.44	15.39	0.0
425W500N	35.34	0.0	0.0
425W500N	45.13	2.215	14.88
425W550N	32.72	0.0	2.607
425W550N	0.253	2.775	6.140
425W550N	0.0	0.0	0.0
450W0N	20.35	0.0	0.0
450W0N	35.51	0.0	19.74
450W0N	19.01	0.0	0.0
450W1000N	39.22	9.688	11.56
450W1000N	0.0	5.700	17.89
450W1000N	44.23	8.350	35.20
450W300N	0.0	31.09	57.92
450W300N	0.0	4.641	44.48
450W300N	0.0	13.58	34.80
450W550N	29.59	38.05	0.0
450W550N	22.15	15.75	9.196
450W550N	3.939	13.69	0.0
450W600N	40.06	0.0	0.0
450W600N	19.45	0.0	33.60
450W600N	5.359	0.0	20.76
450W650N	4.370	0.0	21.71
450W650N	17.22	3.266	0.0
450W650N	20.94	29.12	0.0
450W700N	13.34	4.620	17.14
450W700N	24.33	0.335	0.0
450W700N	30.63	17.10	30.28
450W750N	51.42	3.683	0.0
450W750N	0.0	0.0	18.01
450W750N	0.0	10.63	0.0
450W850N	0.0	8.689	15.99
450W850N	33.31	2.162	3.589
450W850N	9.874	19.44	35.11
450W900N	11.08	31.96	10.43
450W900N	0.0	5.842	18.28
450W900N	13.17	9.284	26.82
450W950N	0.0	16.29	33.14
450W950N	0.0	9.748	0.0
450W950N	16.56	34.91	0.0
500W800N	38.51	8.017	68.34
500W800N	8.566	0.0	49.11
500W800N	79.82	0.0	22.29
500W0N	29.80	15.45	31.23
500W0N	0.0	2.528	0.0
500W0N	14.91	0.0	3.757
500W1000N	1.093	0.0	3.468
500W1000N	0.0	0.0	65.89
500W1000N	44.31	0.0	54.73
500W100N	24.83	0.0	0.0
500W100N	42.89	0.0	0.0
500W100N	1.871	0.0	6.240
500W150N	0.0	0.0	9.432
500W150N	6.693	0.0	0.0

500W150N	22.81	0.0	7.154
500W200N	42.67	10.74	0.0
500W200N	8.936	10.21	1.961
500W200N	44.95	0.0	0.0
500W250N	27.89	47.39	13.93
500W250N	2.652	27.17	47.17
500W250N	16.86	36.01	33.26
500W300N	11.98	26.16	42.07
500W300N	51.69	22.02	52.98
500W300N	14.82	41.63	54.36
500W350N	91.27	10.36	63.73
500W350N	43.96	37.03	62.97
500W350N	60.65	36.12	68.81
500W400N	44.32	19.87	10.74
500W400N	21.72	0.0	42.64
500W400N	27.91	25.46	0.0
500W450N	61.95	45.72	44.16
500W450N	35.17	42.27	43.09
500W450N	71.42	60.06	33.95
500W500N	46.47	0.0	0.0
500W500N	9.246	8.561	0.0
500W500N	23.57	11.45	23.11
500W50N	15.98	8.206	12.55
500W50N	0.473	5.952	0.0
500W50N	19.82	7.232	10.32
500W550N	41.33	0.0	27.15
500W550N	1.918	0.0	13.64
500W550N	39.57	7.039	12.66
500W600N	17.78	0.0	44.19
500W600N	4.439	5.392	0.330
500W600N	15.39	0.0	0.0
500W650N	18.31	0.127	12.93
500W650N	0.0	10.84	0.0
500W650N	1.393	0.0	14.15
500W700N	0.0	0.0	24.18
500W700N	24.81	2.054	42.59
500W700N	14.10	0.0	50.28
500W750N	0.0	2.656	62.53
500W750N	1.020	16.76	50.51
500W750N	52.10	8.452	74.35
500W850N	41.14	38.67	69.65
500W850N	125.7	3.199	66.13
500W850N	59.05	27.23	0.0
500W900N	0.0	10.24	0.0
500W900N	44.62	10.53	0.0
500W900N	10.40	8.321	0.0
500W950N	30.11	7.207	0.0
500W950N	22.53	0.0	5.370
500W950N	15.66	0.0	0.0
50W50N	62.19	48.97	8.513
50W50N	103.0	140.8	40.46
50W50N	164.7	280.0	20.69
50W100N	21.35	61.24	57.90
50W100N	87.81	26.11	64.47

50W100N	13.93	21.86	53.13
50W125N	87.53	12.32	58.18
50W125N	87.02	70.57	77.94
50W125N	18.60	6.716	9.447
50W25N	43.87	10.96	81.13
50W25N	0.0	18.83	31.96
50W25N	26.83	8.887	59.51
50W275N	40.66	74.46	21.51
50W275N	50.05	50.05	54.47
50W275N	88.57	62.33	46.01
50W300N	72.54	40.96	31.38
50W300N	50.68	66.99	6.198
50W300N	68.36	76.58	35.40
50W325N	8.630	21.63	11.01
50W325N	25.76	30.76	63.46
50W325N	0.0	68.35	21.65
50W450N	35.14	19.86	62.37
50W450N	72.06	38.93	46.92
50W450N	53.08	49.74	59.79
550W0N	35.97	19.24	1.916
550W0N	33.47	0.0	18.57
550W0N	32.06	17.61	9.974
550W1000N	0.0	12.43	17.49
550W1000N	26.62	23.05	0.0
550W1000N	42.46	19.94	0.0
550W1050N	35.58	9.710	78.18
550W1050N	34.12	0.0	54.38
550W1050N	9.468	0.0	30.28
550W250N	51.03	0.0	9.234
550W250N	22.25	0.0	22.23
550W250N	48.20	49.49	0.0
550W300N	36.89	22.37	13.62
550W300N	48.58	0.0	17.64
550W300N	77.43	27.73	31.02
550W400N	29.62	27.87	58.49
550W400N	9.445	18.43	44.88
550W400N	39.06	0.0	34.62
550W450N	0.0	9.124	0.0
550W450N	40.85	0.0	10.69
550W450N	47.87	0.0	0.0
550W500N	21.11	41.57	30.04
550W500N	70.50	0.0	54.21
550W500N	34.15	19.88	0.0
550W525N	7.397	12.77	2.229
550W525N	47.44	20.84	0.0
550W525N	71.81	18.72	0.0
550W550N	8.260	0.0	0.590
550W550N	46.51	20.57	28.70
550W550N	11.50	0.0	0.0
550W600N	25.74	0.0	0.0
550W600N	0.0	0.0	0.0
550W600N	62.26	0.0	1.416
550W650N	24.28	0.0	9.058
550W650N	26.15	0.0	0.0

550W650N	0.0	0.0	3.862
550W700N	16.67	0.0	8.999
550W700N	16.27	0.0	10.87
550W700N	0.0	6.315	0.0
550W750N	0.0	0.0	36.78
550W750N	37.76	2.420	18.71
550W750N	0.0	0.0	25.89
550W800N	0.0	0.0	0.0
550W800N	0.0	0.0	29.27
550W800N	18.78	14.05	33.07
550W850N	12.05	0.0	0.0
550W850N	0.0	0.0	0.552
550W850N	0.0	18.42	0.0
550W900N	0.0	2.822	6.853
550W900N	15.75	4.694	45.15
550W900N	21.50	0.0	56.65
550W950N	47.67	0.0	50.12
550W950N	6.095	15.66	8.470
550W950N	20.17	0.0	6.668
575W1000N	0.0	0.0	25.21
575W1000N	26.64	3.275	0.0
575W1000N	22.28	7.987	22.42
575W1050N	25.48	0.0	79.16
575W1050N	19.47	3.975	4.247
575W1050N	64.02	0.0	82.52
575W550N	0.0	0.0	0.0
575W550N	4.706	3.903	0.0
575W550N	40.29	0.0	10.16
575W600N	49.93	0.0	4.00
575W600N	20.03	1.284	0.0
575W600N	34.50	0.0	26.33
575W650N	0.0	0.0	40.52
575W650N	56.78	0.0	0.0
575W650N	0.0	0.0	43.17
600W0N	10.64	17.14	36.65
600W0N	51.95	24.44	0.0
600W0N	61.09	12.81	20.58
600W200N	42.64	37.84	29.44
600W200N	52.79	33.77	45.66
600W200N	8.938	22.59	42.30
600W350N	6.906	22.60	66.35
600W350N	55.62	18.92	11.87
600W350N	39.95	31.36	15.10
650W500N	34.53	14.36	8.715
650W500N	0.0	0.0	0.0
650W500N	0.0	9.833	0.0
75W100N	25.51	0.0	8.084
75W100N	63.87	35.81	12.48
75W100N	27.21	34.56	26.83
75W125N	111.4	85.72	42.40
75W125N	96.03	99.99	22.79
75W125N	162.1	232.6	0.0
75W150N	53.44	47.43	11.82
75W150N	64.10	55.50	52.36

75W150N	133.2	62.45	52.59
75W175N	32.03	32.68	64.13
75W175N	32.58	38.79	49.17
75W175N	56.44	69.43	68.35
75W200N	132.9	74.43	65.76
75W200N	48.25	51.37	60.98
75W200N	60.07	61.21	39.87
75W225N	76.67	32.20	54.18
75W225N	17.28	68.11	8.323
75W225N	67.00	38.42	28.63
75W250N	144.2	49.56	60.73
75W250N	66.01	51.74	56.24
75W250N	108.6	69.17	59.26
75W25N	39.19	0.0	79.35
75W25N	27.52	0.0	59.55
75W25N	55.27	0.0	73.89
75W275N	152.8	64.81	25.39
75W275N	116.5	81.28	9.049
75W275N	71.25	43.93	56.04
75W300N	46.28	66.26	40.03
75W300N	57.03	58.79	9.645
75W300N	105.1	79.52	29.44
75W325N	0.0	10.71	22.11
75W325N	27.04	47.23	17.29
75W325N	37.93	31.93	25.56
75W50N	17.82	55.48	28.59
75W50N	65.36	95.07	57.18
75W50N	90.80	218.2	42.01

APPENDIX E

TERRAIN CONDUCTIVITY DATA

Appendix C (Terrain Conductivity Data) includes the computer printout of the measured conductivity as well as graphs of the conductivity for each traverse lines. Traverse lines are shown on Figure 3-2 of the report.

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 0_W	Date	5/23/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
10	64.00	79.00	71.50	-10.49	.00	power line above, metallic pipe belo
50	62.00	65.00	63.50	-2.36	.00	surface metal object 10' away
100	56.00	55.00	55.50	0.90	.00	surface metal 10' away, power line a
150	54.00	44.00	49.00	10.20	.00	2' from concrete slate, power line
200	21.50	23.00	22.25	-3.37	.00	metal sheeting 10' away
250	34.00	34.00	34.00	0.00	.00	metal gas tanks 15' away
300	41.50	Negative			.00	20' from gas tank
350	32.00	59.00	45.50	-29.67	.00	15' from metal entrance fence
400	50.00	48.00	49.00	2.04	.00	5' from storage shed with metallic

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 50_W	Date	5/23/89
		E&E Personnel	Chris Lewicki/Amin Ayubchs

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
10	Negative	2.50	2.50		.00	50' from power line
50	16.80	15.00	15.90	5.66	.00	10' from metal strip, on dirt road
100	17.20	17.50	17.35	-0.86	.00	20' from metal strip, on dirt road
150	17.90	17.90	17.90	0.00	.00	on dirt road
200	18.20	17.70	17.95	1.39	.00	on dirt road, 10' from metal strip
250	18.20	17.50	17.85	1.96	.00	on dirt road, 10' from metal strip
300	20.50	24.20	22.35	-8.28	.00	on dirt road, 10' from metal strip
350	12.50	15.80	14.15	-11.66	.00	on dirt road, 5' from storage shed

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 100_W	Date	5/23/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
10	23.20	23.20	23.20	0.00	.00	20' from metal object
40	18.80	19.50	19.15	-1.83	.00	15' from metal object
100	17.00	16.50	16.75	1.49	.00	on edge of dirt road
150	18.50	19.10	18.80	-1.60	.00	on edge of dirt road
200	20.20	20.50	20.35	-0.74	.00	15' from car
250	21.20	21.50	21.35	-0.70	.00	10' E of line, 10' from cars
300	27.00	28.00	27.50	-1.82	.00	10' E of line, 25' from fence
350	20.50	20.20	20.35	0.74	.00	10' from metal post, on dirt road

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 180_W	Date	5/23/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
0	17.20	17.50	17.35	-0.86	.00	on grass
50	23.00	22.30	22.65	1.55	.00	on gravel road, 10' from storage roof
100	60.50	52.30	56.40	7.27	.00	on gravel road, 10' from storage roof
150	Negative	Negative			.00	on gravel road, 10' from storage roof
200	19.00	20.00	19.50	-2.56	.00	

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 240_W	Date	5/23/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
0	38.00	39.00	38.50	-1.30	.00	Not inside shed
50	33.00	34.00	33.50	-1.49	.00	
100	31.00	33.00	32.00	-3.13	.00	
150	30.00	29.80	29.90	0.33	.00	
200	31.00	31.00	31.00	0.00	.00	near metal can
250	14.20	14.50	14.35	-1.05	.00	outside shed on dirt road
310	17.50	16.00	16.75	4.48	.00	20' from shed with metal roof

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 250_W	Date	5/24/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
500	21.00	21.50	21.25	-1.18	.00	30' from metal fence, in mud
550	37.00	38.00	37.50	-1.33	.00	in mud
600	30.00	1.00	15.50	93.55	.00	10' from metal object, in mud
650	14.00	13.80	13.90	0.72	.00	on grass, between cars
725	20.80	19.50	20.15	3.23	.00	15' from truck, above surface drainage

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 280_W	Date	5/23/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
15	18.50	18.20	18.35	0.82	.00	20' from metal fence, next to shed
50	22.50	22.50	22.50	0.00	.00	between 2 storage sheds,metallic roofs,
100	27.50	32.00	29.75	-7.56	.00	supports and a concrete foundation.
150	31.50	35.00	33.25	-5.26	.00	same as above
200	13.20	13.50	13.35	-1.12	.00	30' from storage shed
250	14.50	14.50	14.50	0.00	.00	power line above, 50' from shed

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 300_W	Date	5/24/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
500	28.00	47.00	37.50	-12.67	.00	15' from metal shed
550	16.50	17.00	16.75	-0.75	.00	15' from metal shed
575	16.00	16.00	16.00	0.00	.00	15' from truck, in mud
650	14.00	14.50	14.25	-0.88	.00	10' between cars, on grass
700	16.50	15.20	15.85	2.05	.00	10' from truck, on dirt

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 350_W	Date	5/23/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
15	14.20	13.90	14.05	1.07	.00	10' from shed with metal roof
50	22.00	21.20	21.60	1.85	.00	10' from shed with metal roof
100	18.80	20.50	19.65	-4.33	.00	10' from shed with metal roof
150	16.20	16.20	16.20	0.00	.00	20' from same shed
200	14.20	14.20	14.20	0.00	.00	40' from same shed
250	14.90	14.90	14.90	0.00	.00	40' from same shed
300	17.50	16.50	17.00	2.94	.00	power line above 20' from shed

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 350_W	Date	5/24/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
550	20.50	20.00	20.25	1.23	.00	10' from metal sheds
610	39.00	10.50	24.75	57.58	.00	15' from metal farm object
650	19.50	19.50	19.50	0.00	.00	15' from metal storage
700	17.50	17.50	17.50	0.00	.00	overhead power line,20'from metal silo

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 400_W	Date	5/24/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
0	13.20	13.20	13.20	0.00	.00	dirt road, wood piles nearby
50	13.50	13.50	13.50	0.00	.00	dirt road, wood piles nearby
100	14.00	13.90	13.95	0.36	.00	dirt road, wood piles nearby
150	13.20	13.20	13.20	0.00	.00	dirt road, wood piles nearby
200	13.50	13.50	13.50	0.00	.00	dirt road, wood piles nearby
250	16.50	16.50	16.50	0.00	.00	near metal object
300	8.00	11.80	9.90	-19.19	.00	dirt road, wood piles nearby

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 450_W	Date	5/24/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
0	4.20	12.80	8.50	-50.59	.00	near metal dog fence, metal pole
50	13.50	13.50	13.50	0.00	.00	3' from puddle
100	13.20	13.20	13.20	0.00	.00	near lumber
150	13.00	13.00	13.00	0.00	.00	near lumber
200	14.00	14.00	14.00	0.00	.00	near lumber
250	30.00	31.00	30.50	-1.64	.00	near lumber
300	9.50	23.00	16.25	-41.5%	.00	near lumber,puddle,10'from power line

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 450_W	Date	5/24/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
510	18.00	17.50	17.75	1.41	.00	10' from shed w/metal roof
530	21.00	22.00	21.50	-2.33	.00	1' from tires, 5' from metal sheet
550	15.50	16.00	15.75	-1.59	.00	5' from metal sheet, 15' from truck
570	14.20	14.10	14.15	0.35	.00	10' from cars
590	14.80	15.00	14.90	-0.67	.00	10' from cars
610	14.90	15.20	15.05	-1.00	.00	8' from metal sheet
630	14.20	14.10	14.15	0.35	.00	10' from metal truck
650	14.20	14.20	14.20	0.00	.00	8' from metal truck
670	13.50	14.00	13.75	-1.82	.00	5' from wood post
690	14.00	14.20	14.10	-0.71	.00	15' from metal object
700	14.20	14.20	14.20	0.00	.00	
710	16.00	15.00	15.50	3.23	.00	
730	23.00	22.50	22.75	1.10	.00	20' from greenhouse w/metal on it
900	17.00	16.00	16.50	3.03	.00	10' from greenhouse, but no effect
920	15.00	15.00	15.00	0.00	.00	on grass, on slope
930	14.50	14.80	14.65	-1.02	.00	on grass, on slope
950	14.90	14.50	14.70	1.36	.00	on grass, on slope
970	16.20	16.20	16.20	0.00	.00	on grass, on slope
990	17.20	17.50	17.35	-0.86	.00	on grass, on slope
1010	19.00	19.50	19.25	-1.30	.00	on grass, on slope
1030	2.50	17.50	10.00	-75.00	.00	on wet sand, on slope
1050	18.00	18.00	18.00	0.00	.00	bottom of hill, wet sand

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 500_W	Date	5/24/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
0	16.20	16.00	16.10	0.62	.00	near cable, 10' from shed
50	14.50	13.50	14.00	3.57	.00	grass field
100	13.00	13.00	13.00	0.00	.00	grass field
150	13.50	13.00	13.25	1.89	.00	on top of pile of trees
200	14.20	14.50	14.35	-1.05	.00	on dirt
250	26.00	25.00	25.50	1.96	.00	on dirt, near lumber
300	5.20	29.00	17.10	-69.59	.00	20' from power line, near dirt
325	19.50	19.20	19.35	0.78	.00	20' from power line

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 500_W	Date	5/24/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
530	17.50	17.50	17.50	0.00	.00	10' from shed w/metal roof
570	14.80	14.80	14.80	0.00	.00	1' from tires, 5' from metal sheet
590	15.50	15.00	15.25	1.64	.00	5' from metal sheet, 15' from truck
610	15.20	14.80	15.00	1.33	.00	10' from cars
630	15.20	16.20	15.70	-3.18	.00	10' from cars
650	13.20	13.20	13.20	0.00	.00	8' from metal sheet
670	12.80	12.80	12.80	0.00	.00	10' from metal truck
690	13.00	13.00	13.00	0.00	.00	8' from metal truck
700	13.20	13.20	13.20	0.00	.00	5' from wood post
710	13.20	13.20	13.20	0.00	.00	15' from metal object
730	13.20	13.20	13.20	0.00	.00	
750	13.20	13.50	13.35	-1.12	.00	
770	14.20	14.00	14.10	0.71	.00	20' from greenhouse w/metal on it
790	16.00	16.20	16.10	-0.62	.00	10' from greenhouse, but no effect
870	15.00	15.20	15.10	-0.66	.00	on grass, on slope
890	13.50	13.80	13.65	-1.10	.00	on grass, on slope
910	13.90	13.90	13.90	0.00	.00	on grass, on slope
930	13.50	14.00	13.75	-1.82	.00	on grass, on slope
950	15.50	15.80	15.65	-0.96	.00	on grass, on slope
970	17.00	17.00	17.00	0.00	.00	on grass, on slope
990	18.50	18.50	18.50	0.00	.00	on wet sand, on slope
1010	19.20	19.80	19.50	-1.54	.00	bottom of hill, wet sand
1030	18.20	20.00	19.10	-4.71	.00	
1050	11.00	16.50	13.75	-20.00	.00	

Terrain Conductivity Survey
Data Sheet

Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 550_W	Date	5/24/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
0	17.00	16.00	16.50	3.03	.00	5' from metal pole, open field
50	15.20	15.20	15.20	0.00	.00	open field
100	14.50	14.50	14.50	0.00	.00	open field
150	14.20	14.20	14.20	0.00	.00	open field
200	16.00	16.00	16.00	0.00	.00	open field
270	9.50	26.00	17.75	-46.48	.00	dirt road, 15 ' from lumber

Terrain Conductivity Survey
Data Sheet

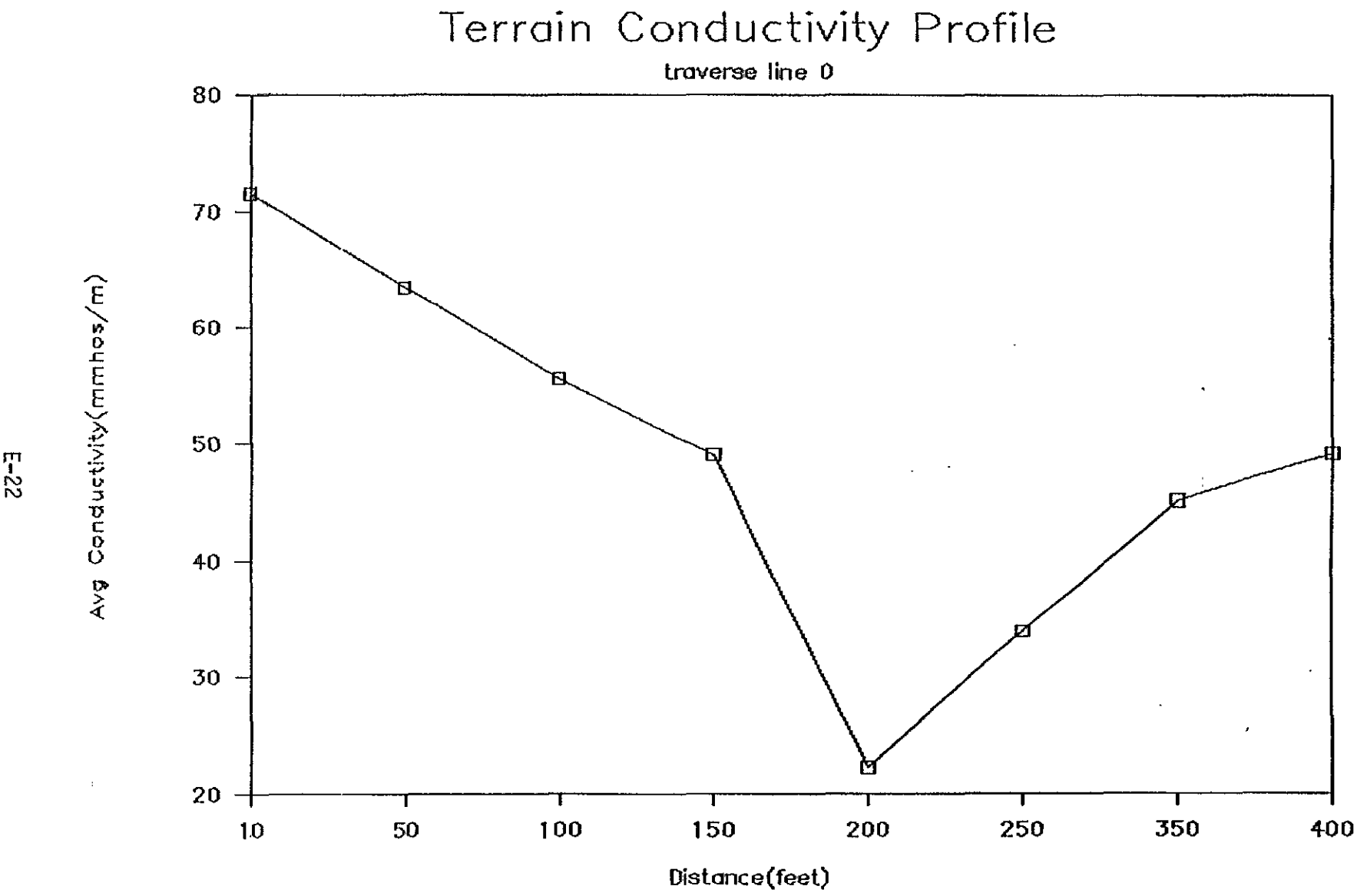
Instrument	Geonic EM-31	Project No.	ZB3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 550_W	Date	5/24/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

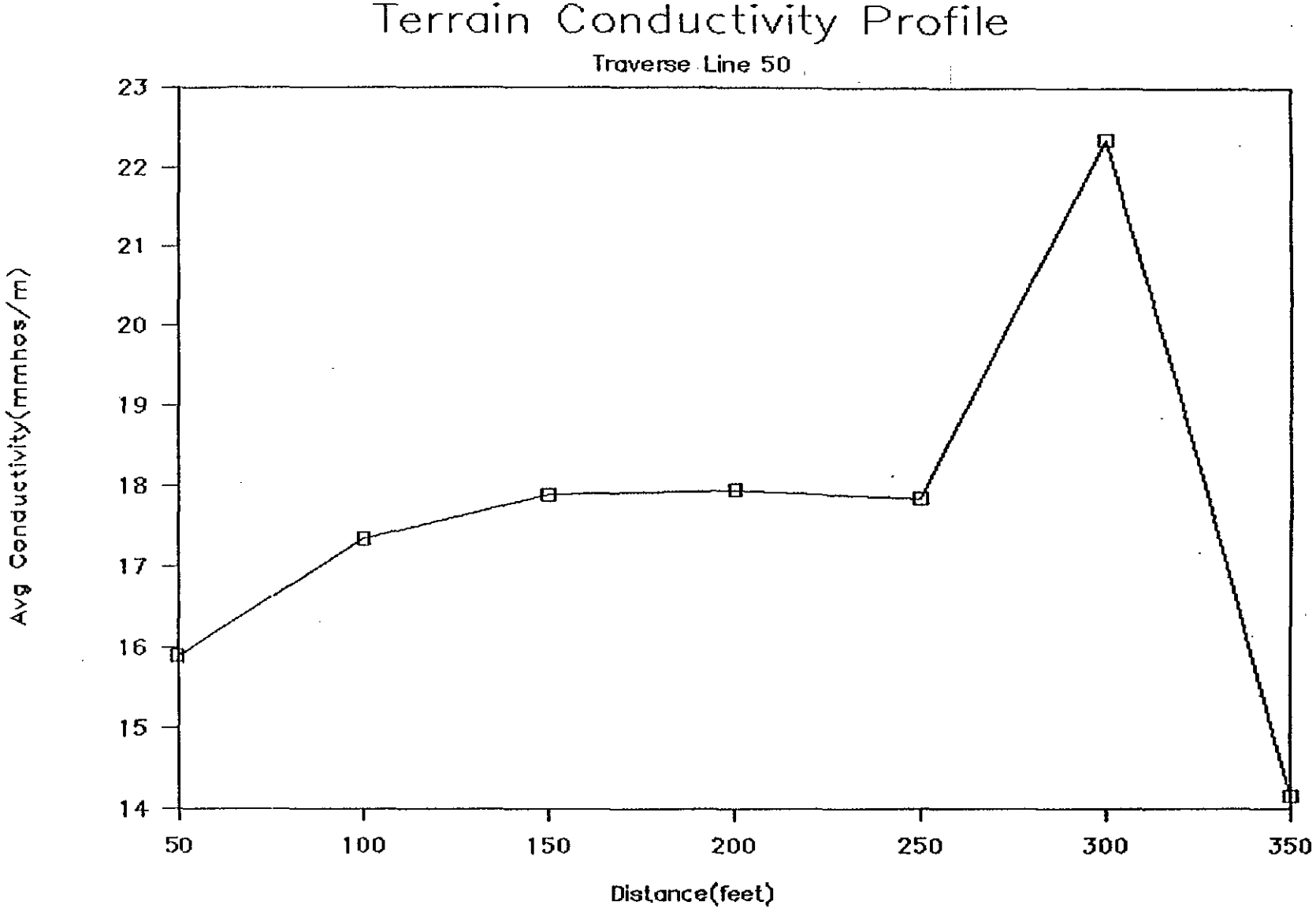
Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
570	14.00	14.50	14.25	-1.75	.00	8' from metal object
590	13.00	13.00	13.00	0.00	.00	15' from metal truck
610	14.00	14.50	14.25	-1.75	.00	5' from metal truck
670	13.70	13.20	13.45	1.86	.00	8' from metal truck
690	12.80	12.80	12.80	0.00	.00	on grass
700	13.00	13.20	13.10	-0.76	.00	on grass
710	13.80	13.80	13.80	0.00	.00	on grass
730	11.80	13.20	12.50	-5.60	.00	in depression on grass
750	13.00	9.20	11.10	17.12	.00	in depression on grass
770	14.90	14.50	14.70	1.36	.00	in depression on grass
790	13.50	13.50	13.50	0.00	.00	almost out of depression
800	13.20	13.20	13.20	0.00	.00	on grass, little depression
810	12.50	12.80	12.65	-1.19	.00	
830	12.50	13.00	12.75	-1.96	.00	
850	12.80	12.20	12.50	2.40	.00	elevated top
870	13.00	13.00	13.00	0.00	.00	elevated top
890	13.00	13.00	13.00	0.00	.00	elevated top
910	13.00	13.00	13.00	0.00	.00	elevated top
930	13.20	13.20	13.20	0.00	.00	on slope
950	14.50	14.50	14.50	0.00	.00	on slope
970	15.00	15.00	15.00	0.00	.00	on slope
990	15.50	16.50	16.00	-3.13	.00	on slope
1010	17.50	18.00	17.75	-1.41	.00	
1030	20.00	20.00	20.00	0.00	.00	on edge of dirt road
1050	19.50	16.50	18.00	8.33	.00	on dirt road, on slope
1070	26.00	25.50	25.75	0.97	.00	on dirt road, on slope

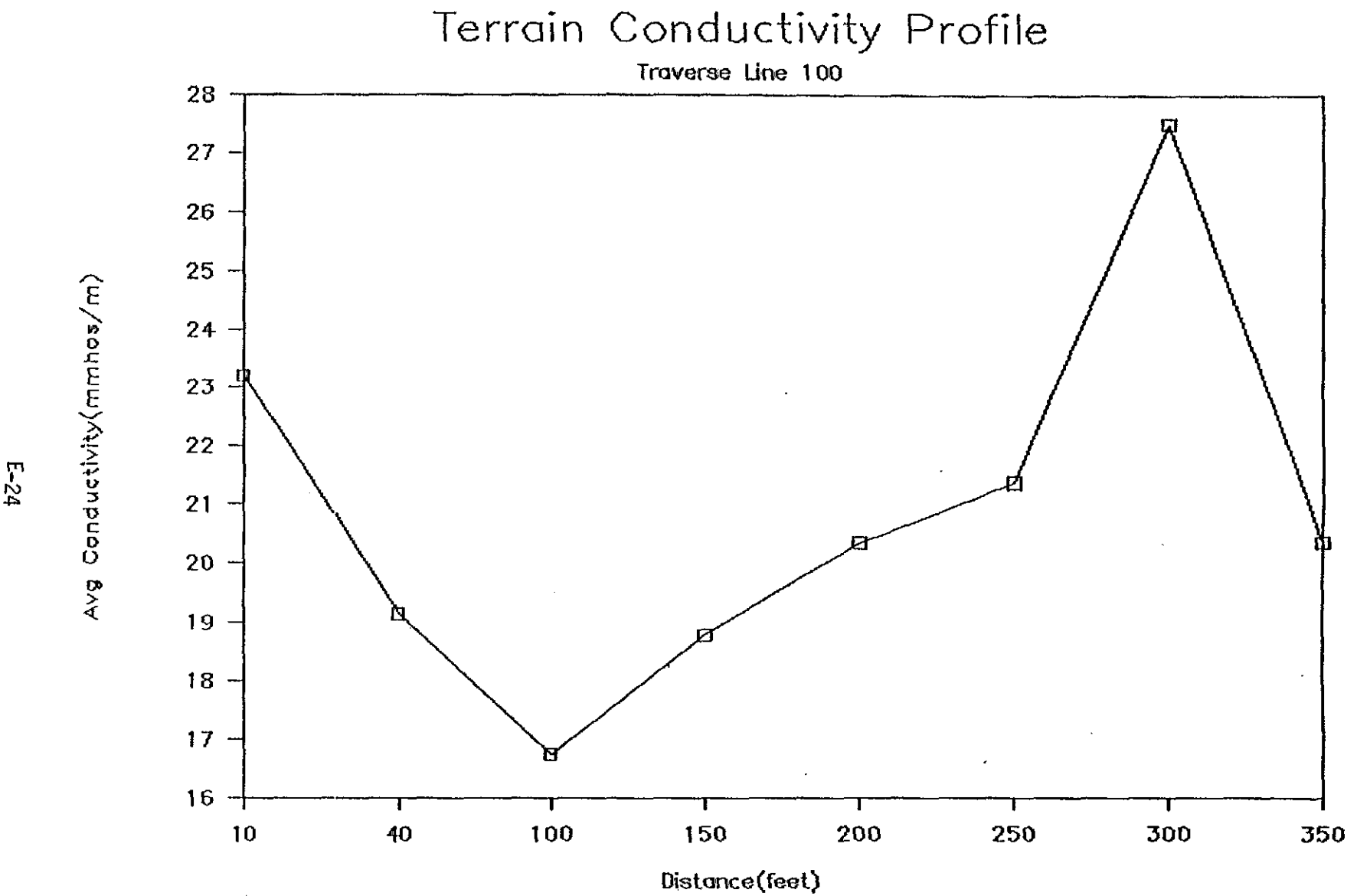
Terrain Conductivity Survey
Data Sheet

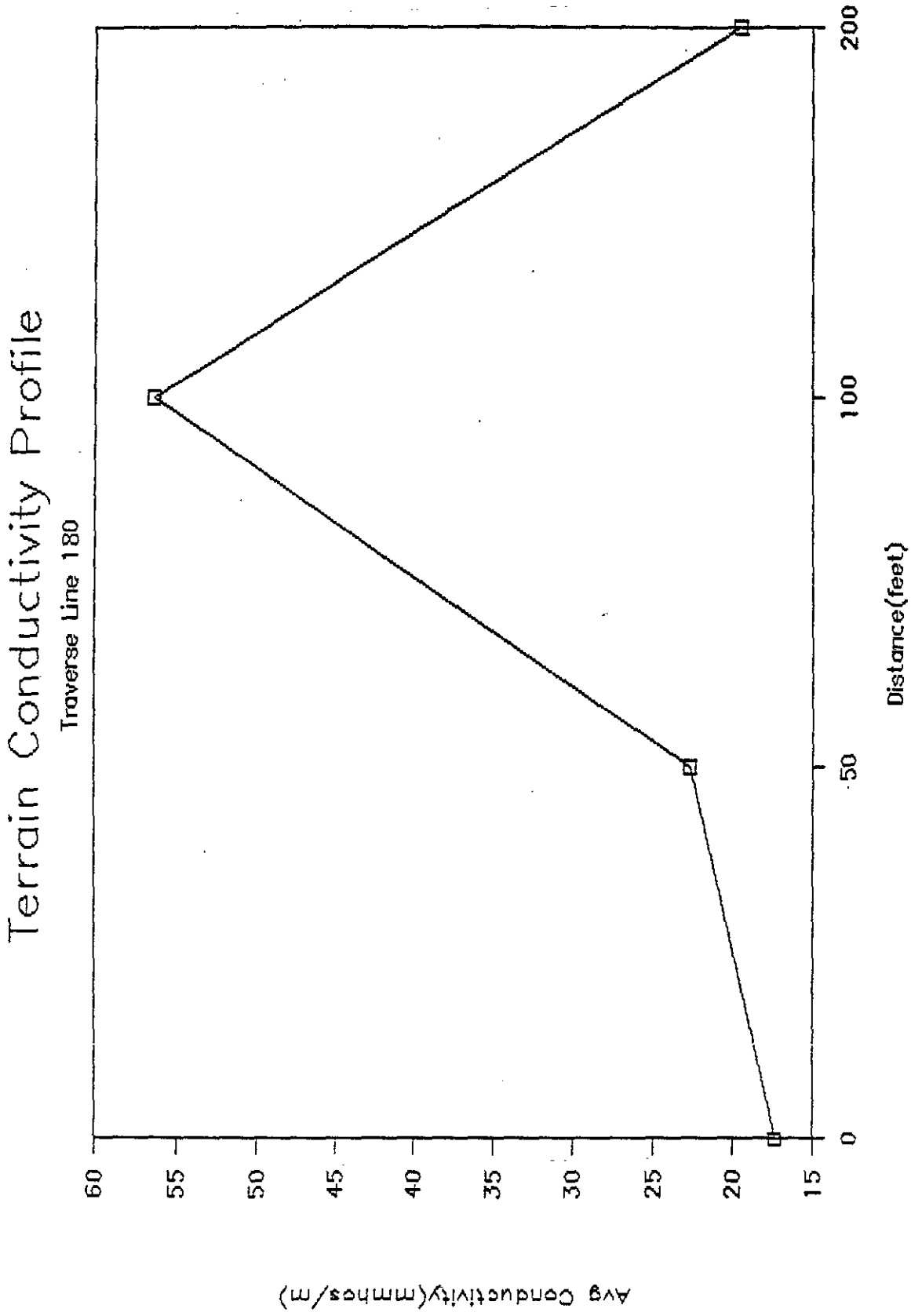
Instrument	Geonic EM-31	Project No.	ZD3000
Coil Separation	A=3.66 m	Client	EPA/Saunder Supply Co.
Dipole Config.	Vertical	Location	Chuckatuck/Suffolk, VA
Comments	Line 580_W	Date	5/24/89
		E&E Personnel	Chris Lewicki/Amin Ayubcha

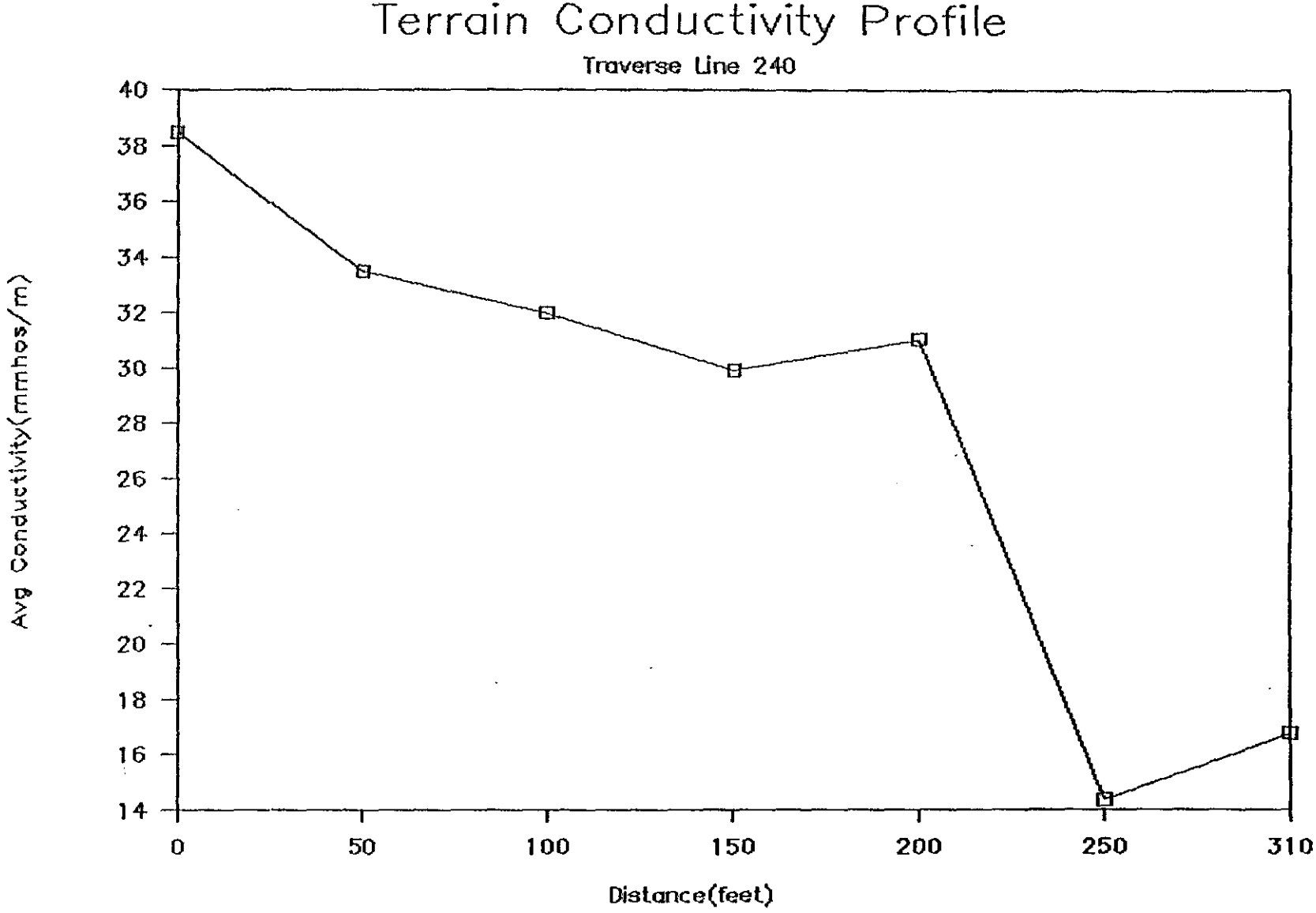
Station	Orientation: N-S Conductivity (millimhos/meter)	Orientation: E-W Conductivity (millimhos/meter)	Average Conductivity (millimhos/meter)	Directionality of conductivity In %	db Units	Remarks
570	14.00	13.80	13.90	0.72	.00	6' from metal object
590	13.80	13.50	13.65	1.10	.00	80' from metal truck
610	12.80	12.80	12.80	0.00	.00	on slope 10' from metal truck
630	14.00	14.00	14.00	0.00	.00	on slope 3' from metal truck
690	12.50	12.80	12.65	-1.19	.00	on top of berm
700	12.50	12.50	12.50	0.00	.00	on top of berm
710	12.20	12.00	12.10	0.83	.00	on top of berm
730	11.80	1.50	6.65	77.44	.00	on slope, west of berm
750	33.00	25.00	29.00	13.79	.00	in depression west of berm
770	17.00	20.00	18.50	-8.11	.00	in depression west of berm
790	19.00	19.00	19.00	0.00	.00	in depression west of berm
800	18.00	18.50	18.25	-1.37	.00	in depression west of berm
810	18.00	18.00	18.00	0.00	.00	in depression west of berm
830	18.00	17.00	17.50	2.86	.00	in depression west of berm
850	18.50	19.00	18.75	-1.33	.00	in depression west of berm
870	19.00	19.50	19.25	-1.30	.00	on slope
890	19.50	19.80	19.65	-0.76	.00	on slope
910	18.00	18.50	18.25	-1.37	.00	on slope
930	16.50	16.80	16.65	-0.90	.00	on top of berm
950	16.50	16.50	16.50	0.00	.00	on grass
970	16.80	16.80	16.80	0.00	.00	on grass
990	18.00	18.50	18.25	-1.37	.00	on grass
1010	18.00	18.90	18.45	-2.44	.00	on sand
1030	18.50	19.00	18.75	-1.33	.00	on sandy dirt edge of road
1050	22.50	22.50	22.50	0.00	.00	opposite edge of dirt road
1070	25.00	25.00	25.00	0.00	.00	on grass near surface water


Terrain Conductivity Profile
traverse line 0
Avg Conductivity(mmhos/m)
80
70
60
50
40
30
20
10
50
100
150
200
250
350
400
Distance(feet)




Terrain Conductivity Profile
Traverse Line 100
Avg Conductivity(mmhos/m)
28
27
26
25
24
23
22
21
20
19
18
17
16
10
40
100
150
200
250
300
350
Distance(feet)





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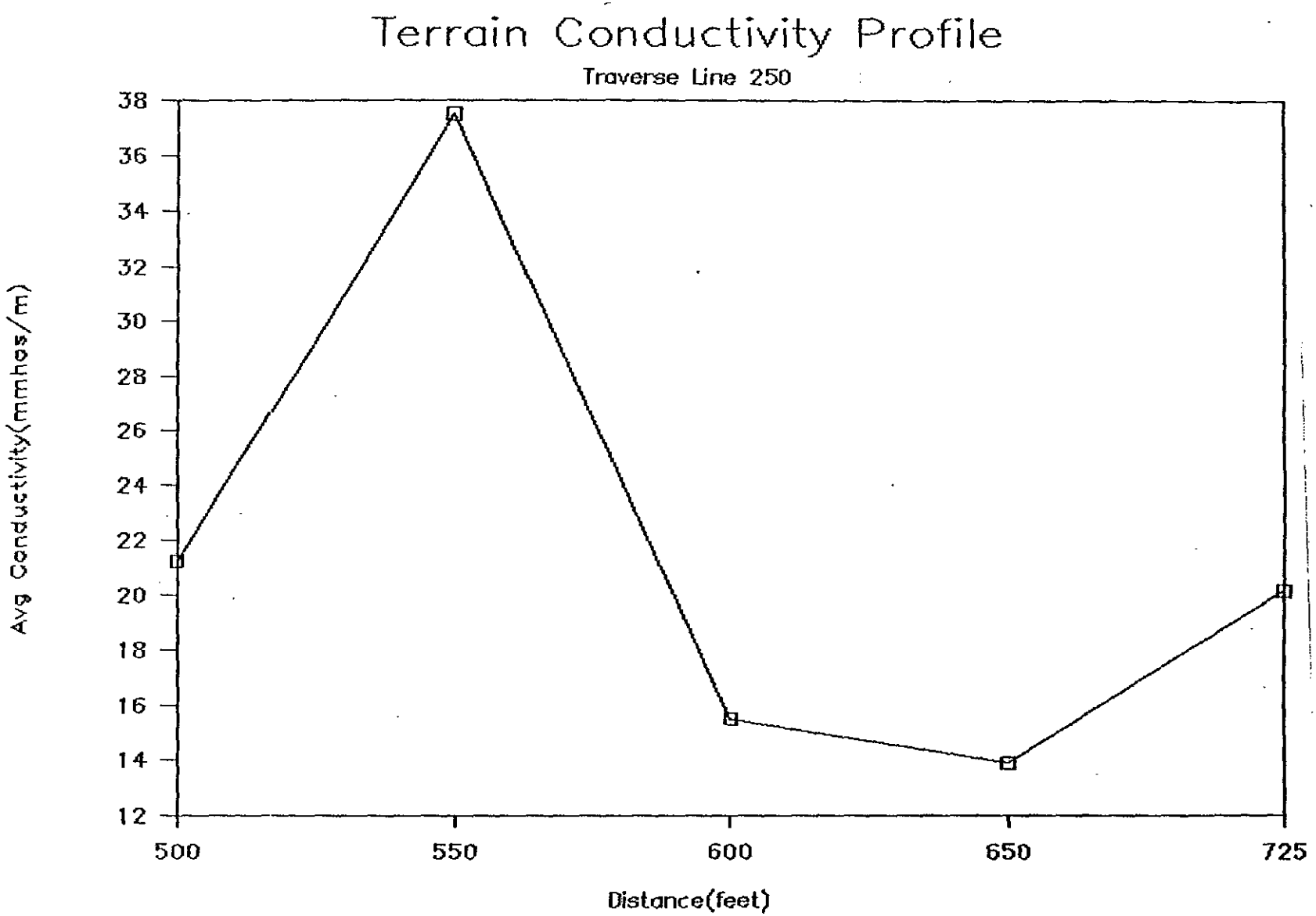
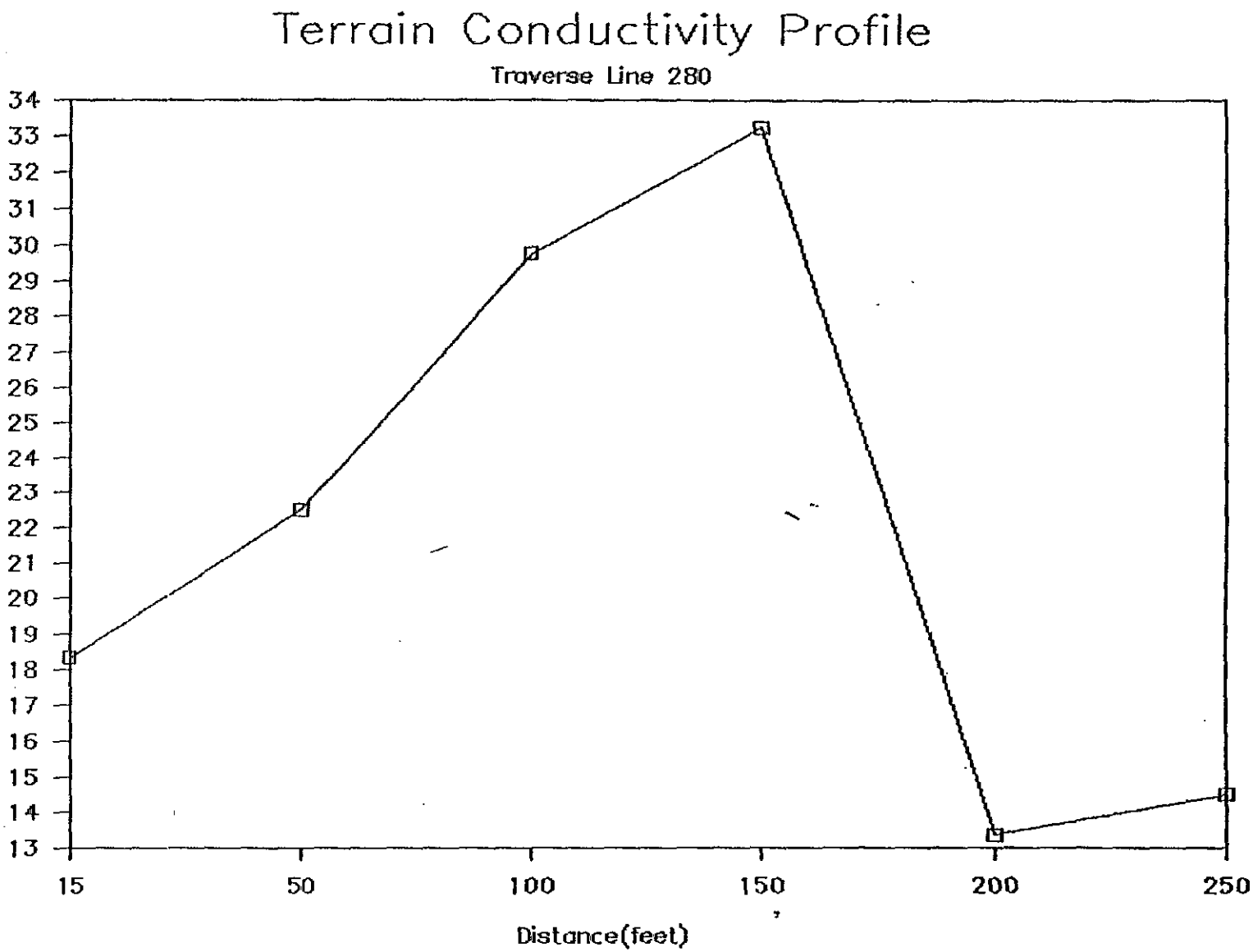
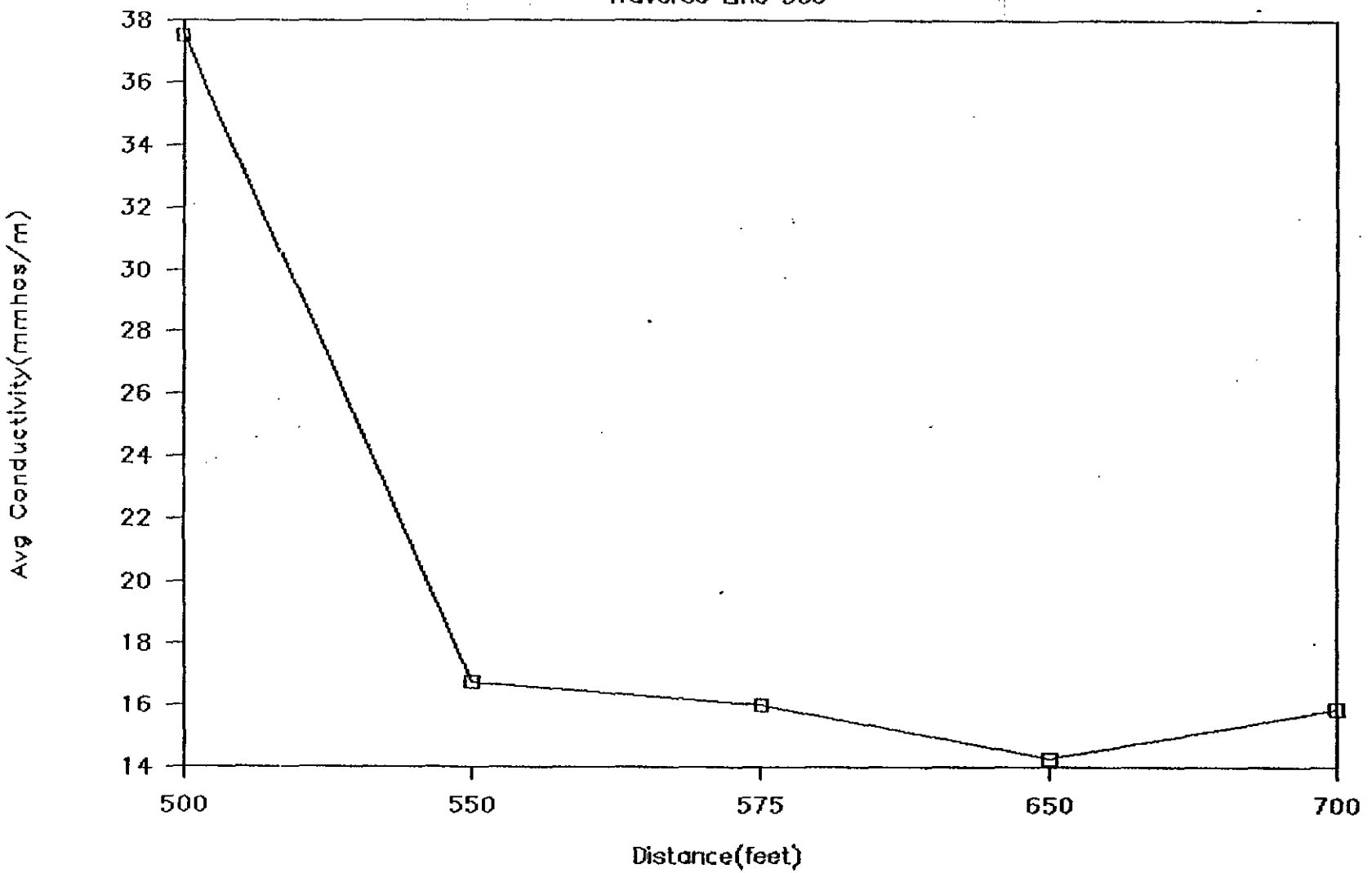
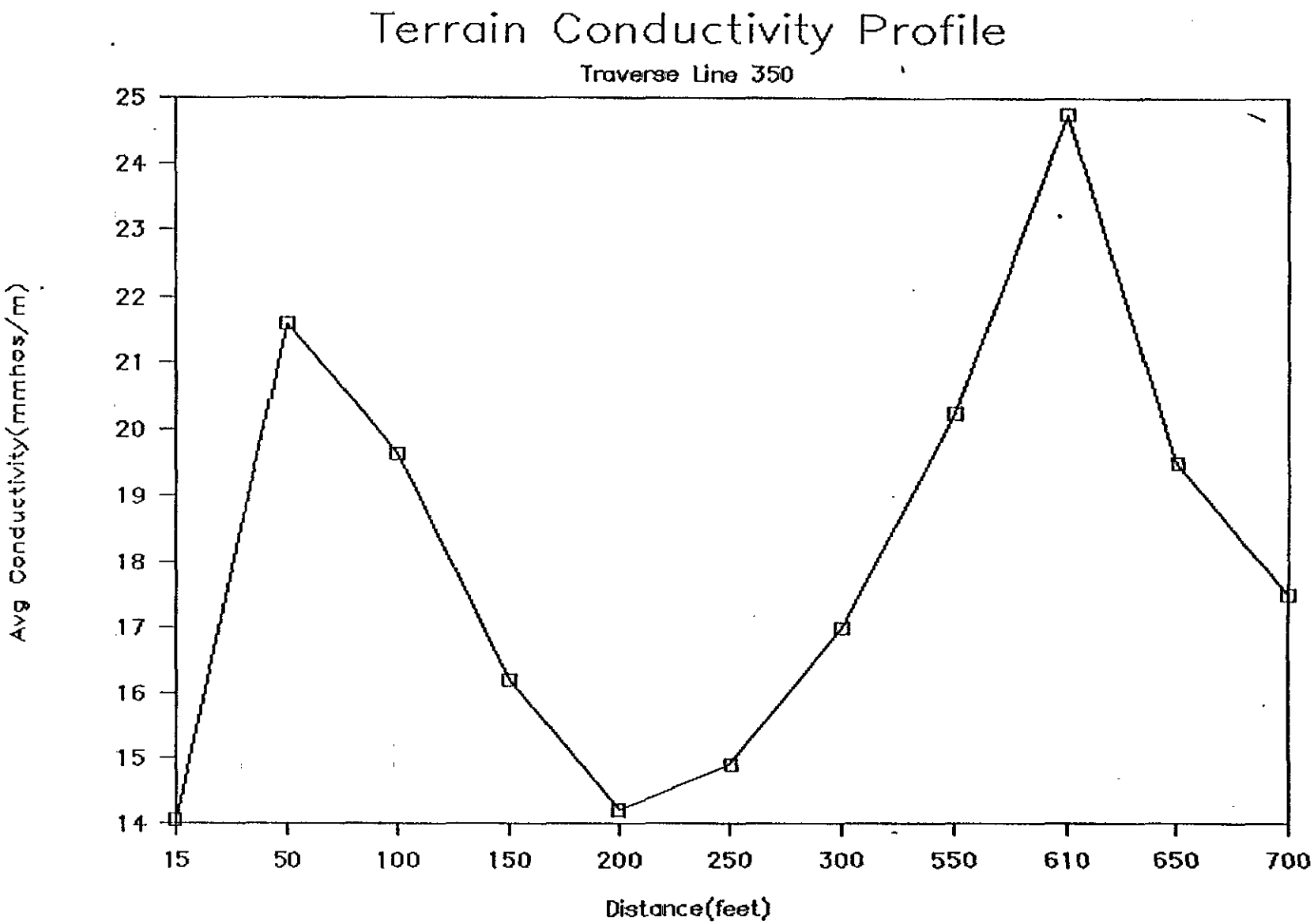


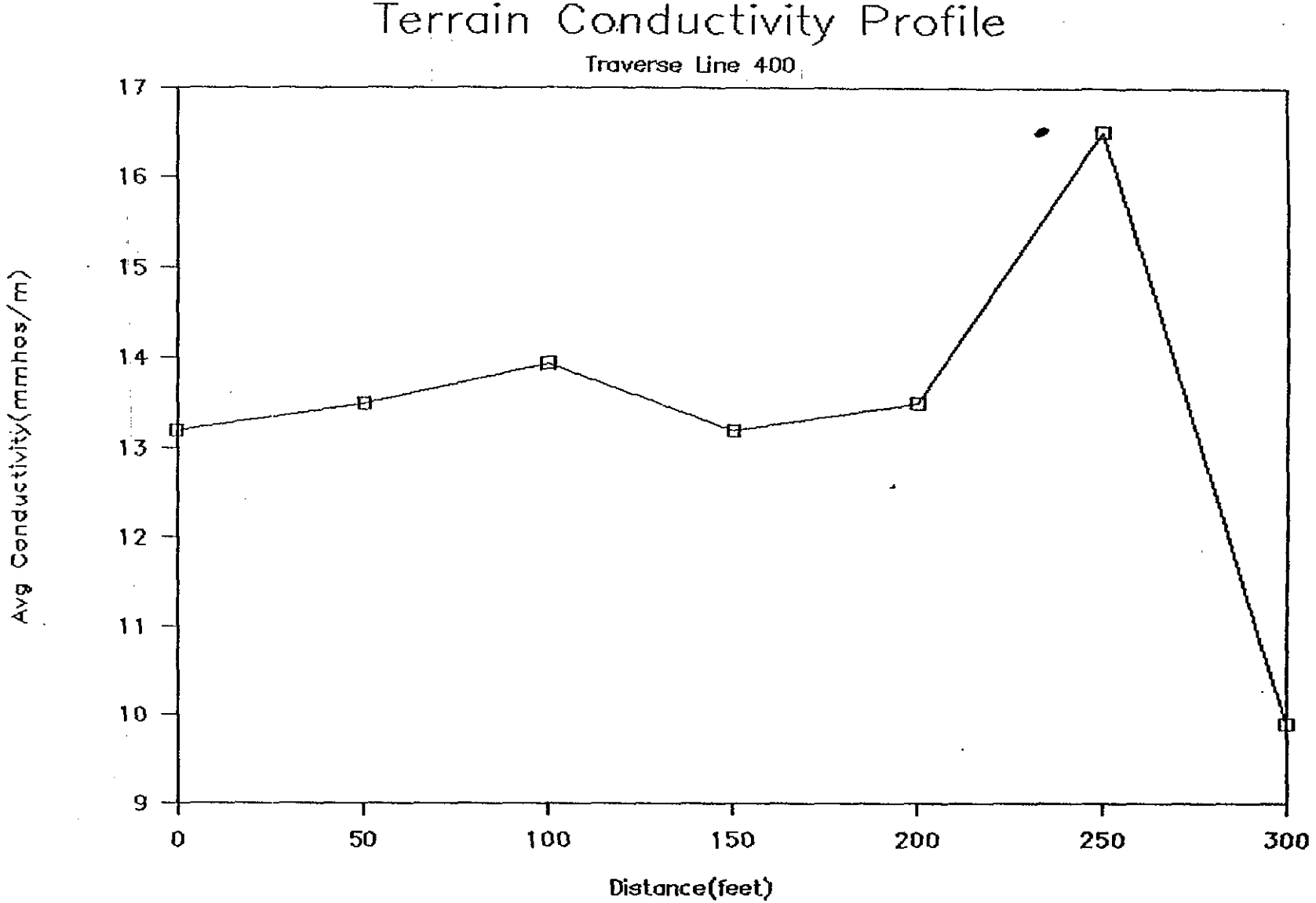

Terrain Conductivity Profile
Traverse Line 280
Avg Conductivity(mmhos/m)
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
15
50
100
150
200
250
Distance(feet)

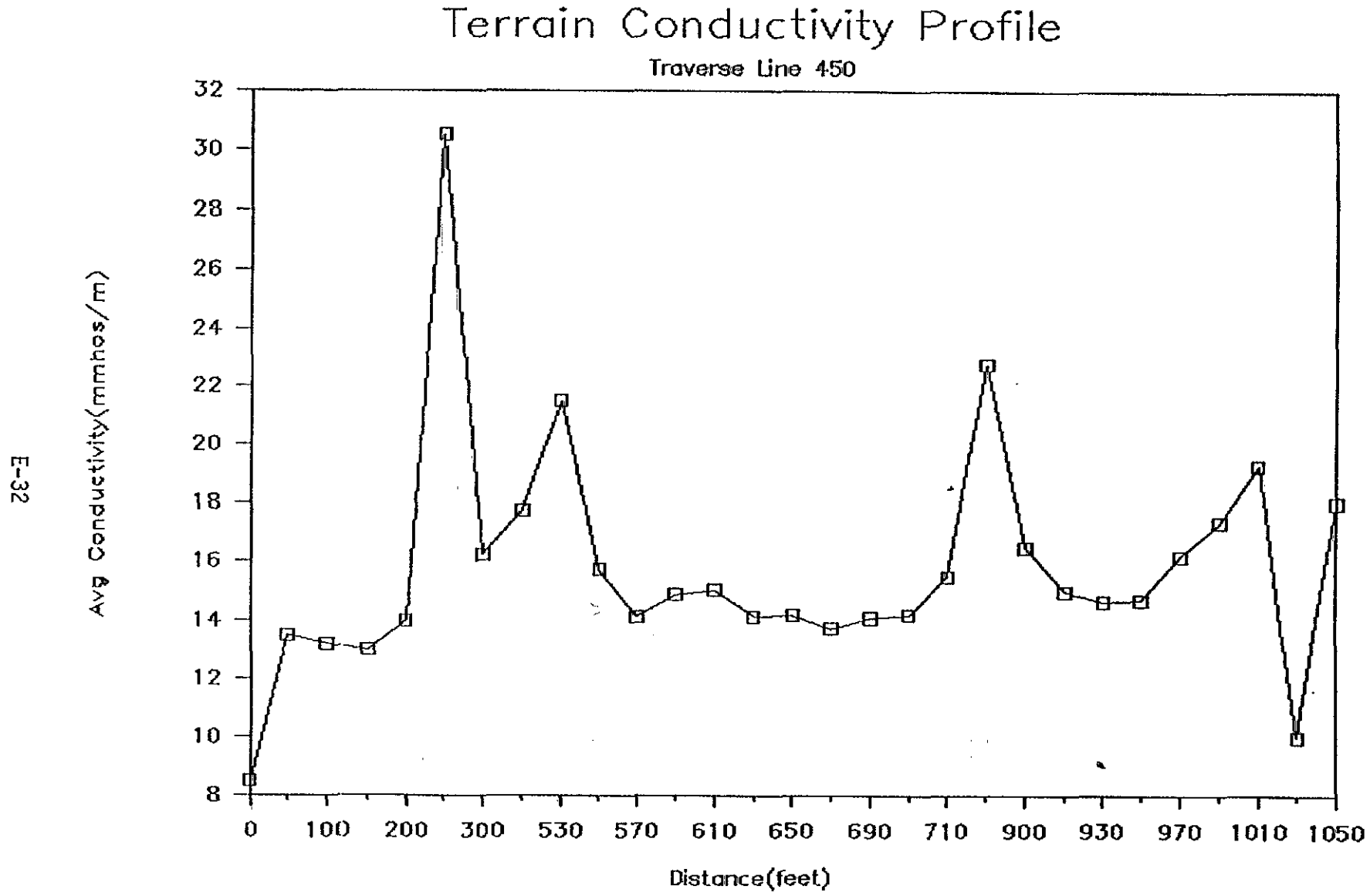
Terrain Conductivity Profile

Traverse Line 300




Terrain Conductivity Profile
Traverse Line 350
Avg Conductivity(mmhos/m)
25
24
23
22
21
20
19
18
17
16
15
14
15
50
100
150
200
250
300
550
610
650
700
Distance(feet)





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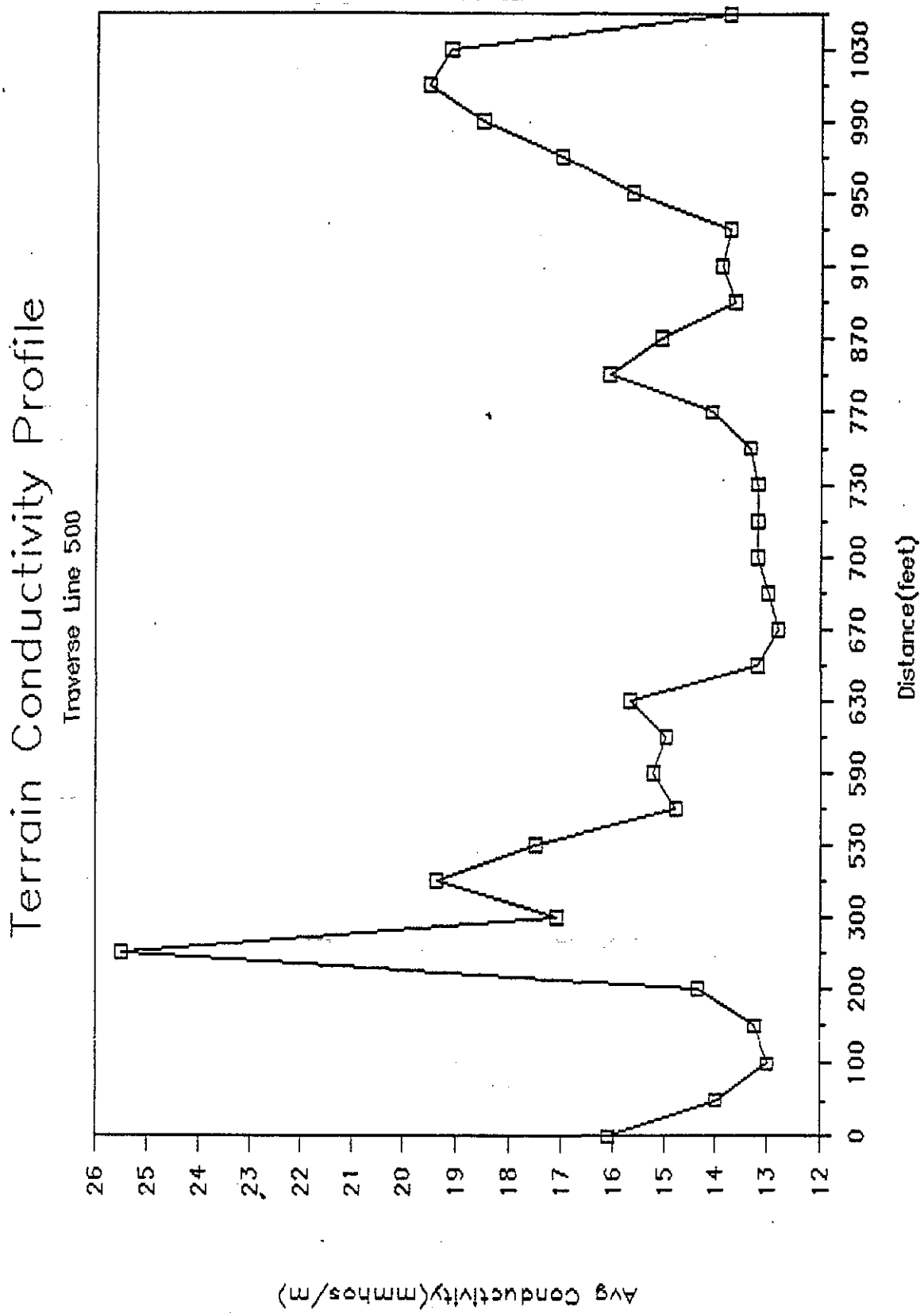
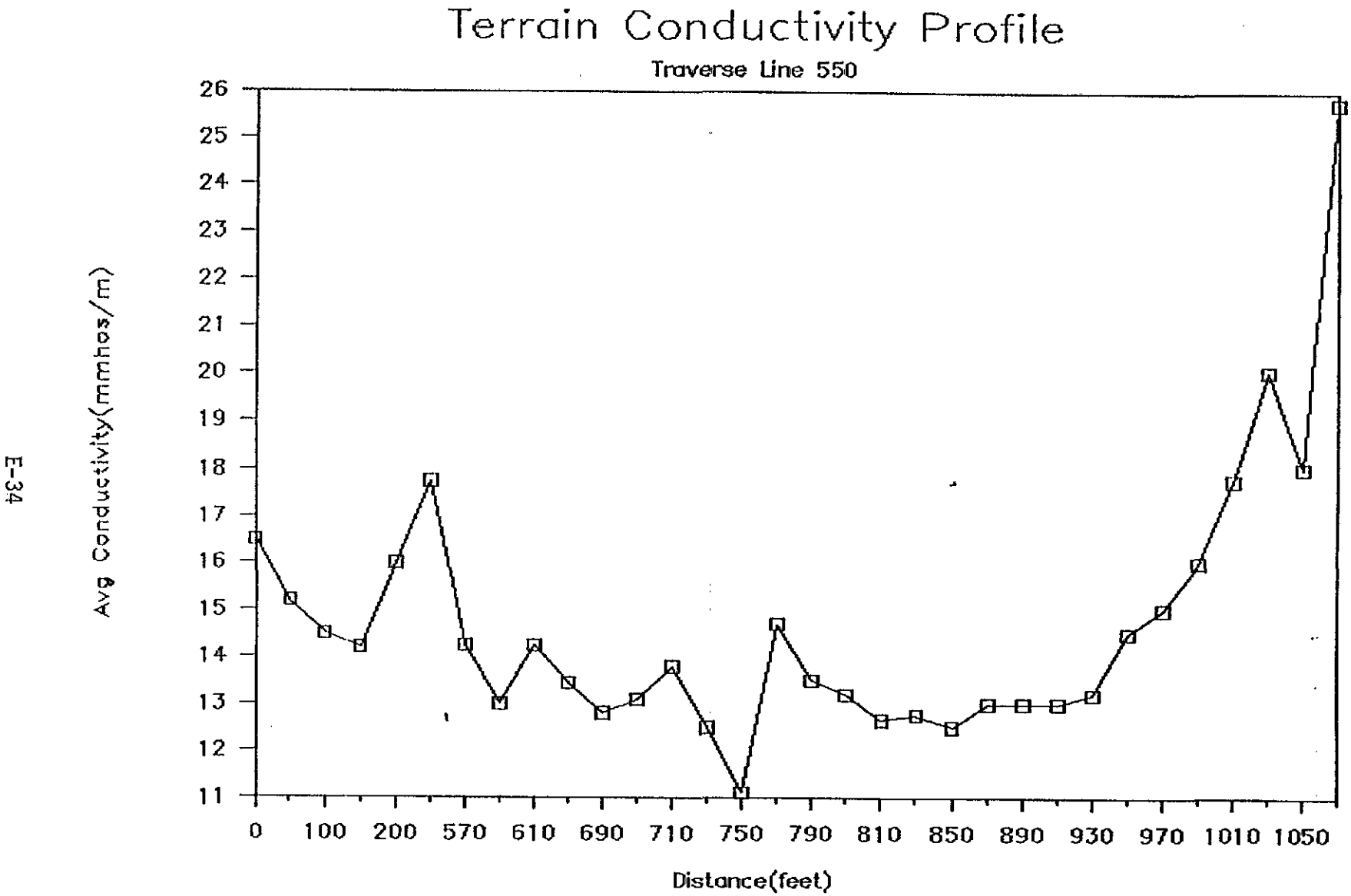
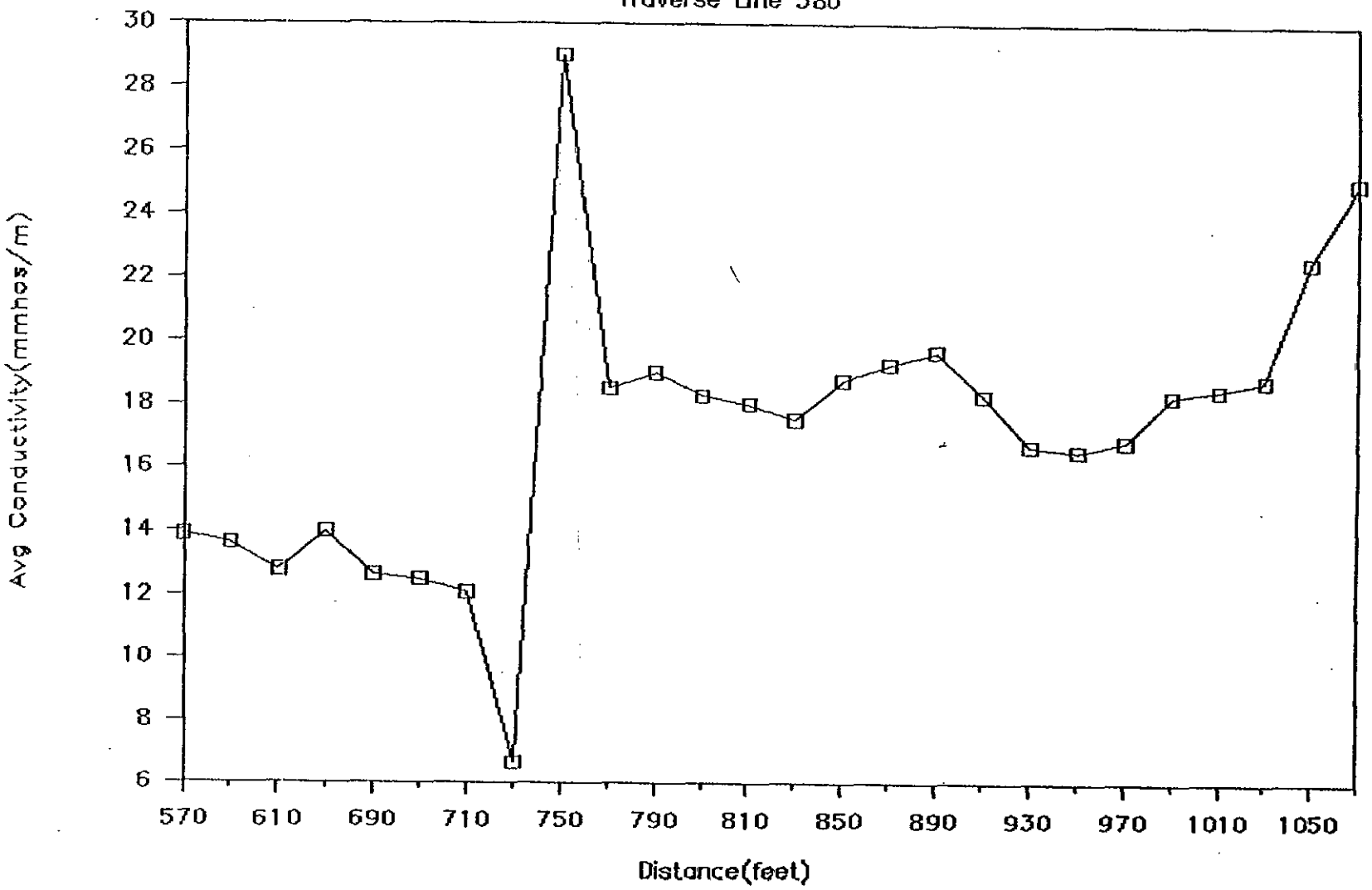



Terrain Conductivity Profile
Traverse Line 550
Avg Conductivity(mmhos/m)
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
0
100
200
570
610
690
710
750
790
810
850
890
930
970
1010
1050
Distance(feet)

Terrain Conductivity Profile

Traverse Line 580



APPENDIX F

COMBUSTION PRODUCT DEPOSITION MODELING REPORT

ecology and environment, inc.
BUFFALO CORPORATE CENTER
368 PLEASANTVIEW DRIVE, LANCASTER, NEW YORK 14086, TEL. 716/684-8060
International Specialists in the Environment

December 22, 1989

Mr. Andrew Palestini
U.S. Environmental Protection Agency
841 Chestnut Street
Philadelphia, PA 19107

Dear Andy:

Find enclosed a completed draft copy of the air deposition modeling task write-up and its accompanying appendix for your review. These documents are considered unedited draft until they become incorporated into the report and subsequently finalized. They are being provided to you as justification for not performing the combustion product deposition sampling program associated with the Saunders Supply Company RI/FS work plan.

As you are aware, the purpose of this modeling task was to provide guidance to locating potential areas of deposition resulting from the burning of sludges at the Saunders Supply Company Site. At the identified locations, soil samples were to be collected for dioxin/furans analysis. It was not the intent of this task to determine ground level deposition concentrations or to model future exposure scenarios.

The results of this effort suggest that deposition occurred in the immediate vicinity of the site. And for the most part within areas which have been sampled and analyzed for dioxin/furans pursuant to the designed surface and subsurface soils sampling programs. Therefore, as we discussed previously during the field investigation program in order to avoid a duplication of effort, the initiation of additional sampling, pursuant to the combustion product deposition sampling program, was not performed.

If you have any questions call me at (716) 684-8060.

Sincerely,

Fred J. McKosky, P.E.
Site Manager

FJM/wj
L/ZD-3033
Encl.

cc: J. Pearson, E & E Philadelphia w/encls.

To: Fred Mckosky, Project Manager
From: Lou Depowski
Re: Estimated distribution of surface deposition of pollutants in the vicinity of: 1)the conical burner at SSC and 2)the open settling basin (Appendix attached)

The problem as decribed was to determine the probable surface distribution of dioxins and furans as a result of combustion of sludge containing pentaclorophenol (PCP) between the years 1969 and 1974. Combustion of the sludge took place in a conical burner unit located at the the north end of the SSC site. The unit had a stack height of approximately 10 meters, a stack diameter of approximately 1 meter and was protected by a rain cap. Since burnings were not scheduled in advance it is assumed emissions took place under a wide variety of meteorological conditions. The following methodology, including assumptions made, was used to determine the distribution of pollutants deposited on ground surfaces in the vicinity of the burner unit.

The deposition distribution pattern surrounding the burner unit is determined by two main factors, the prevailing meteorological conditions and particle size of the emitted pollutants. Since emission rate has no bearing on the distribution of pollutants, no attempt was made to estimate the actual emission values. Instead an arbitrary emission of 1,000 grams total was used during all calculations. Doubling this value would simply double all calculated deposition values, leaving the distribution unchanged. The following data/modifications were also incorporated:

Stack Height: Due to the presence of the protective rain cap the effective stack height was assumed to be equal to the physical stack height(10.0 meters).

Stack Temperature: The exhaust temperature as assumed to be approximately 450 degrees Kelvin. A sensitivity analysis showed the distribution pattern does not change appreciably with a change in exhaust temperature.

Meteorological Conditions: Average annual wind distribution by Pasquill stability classes(STAR Program) from Norfolk NAS, Va. was used to represent the prevailing meteorological conditions at the SSC site. The data was accumulated over a 10 year period from 1/62 to 12/71 by the National Oceanic and Atmospheric Administration.

Particle Size: Uncontrolled burning of the sludge would result in emissions of a wide range of particle sizes. Studies(1) of emissions resulting from uncontrolled burning of distillate oil results show 68%(by mass) of the particulates emitted are less than or equal to 15 microns. Fly ash production could result in particles with diameters of over 100 microns. Since the particulate size distribution was unknown a detailed sensivity analysis was made to determine the effect of particle size on deposition distribution patterns.

Incorporating the above modifications the industrial source complex long term

(ISCLT) computer program was used to determine the distribution patterns. Computer runs were made for various size particles ranging from .005 microns (large gas molecules) to 100 microns (large particles with an appreciable settling velocity of approximately 0.40 m/sec).

The results of the computer runs show almost no variation in the deposition distribution patterns for particles up to about 30 microns. The location of the point of maximum deposition(dmax) for particles in this range was approximately 55 meters (180 ft) due south of the burner unit. Figure 1 shows this point superimposed on the site facilities map. The map also shows the 0.8(dmax) and .5(dmax) isopleths. The distribution patterns for the larger particles show that areas of maximum deposition tend to be located just north of the site. For example, the location of the point of maximum deposition(Dmax) resulting from emissions consisting of a uniform distribution of particles ranging from 40 microns to 100 microns diameter is estimated to be approximately 25 meters (82 ft) north northwest of the burner unit. Figure 2 shows this point and the .5(times maximum depostion value for particles in this size range) isopleth again superimposed on the site map.

Estimates were also made of the probable surface distribution of combustion products resulting from burning sluge at the former oil/water separation basin. located at the point indicated on figures 3 and 4. The basin, located in a ground depression was assumed to have been approximately 5 meters in diameter when the burns took place. It was further assumed there were a number of such burns and that the burns took place under a variety of meteorological conditions.

Using the ISCLT dispersion model, the basin was treated as a ground-level area source incorporating a bouyancy-induced effective emission height of approximately 4 meters. Again, since the total emissions for the basin burnings would not effect the deposition distribution in the vicinity of the basin, an arbitrary emission rate of 50 gram per square meter was used.

Results of computer runs show the point of maximum deposition(Dmax) for gaseous and lighter particulate(less than 30 microns diameter) emissions is located approximately 30 meters directly south of the basin. Figure 3 shows this point superimposed on the site facilities map. The .75Dmax and .5Dmax isopleths show areas of greatest deposition levels would be located south west and northeast of the basin. Computer runs for the larger particulate emissions (particle sizes over 40 microns) show that the point of maximum deposition is located within a few meters to the north of the basin and that most of the larger particulates would be deposited within 20 meters of the basin. Figure 4 shows the point of maximum deposition(Dmax) and the .25Dmax isopleth superimposed on the site facilities map.

(1) "Compilation of Air Pollutant Emission Factors-Volumn 1:Stationary Point and Area Sources", U. S. Environmental Protection Agency Office of Air Quality Planning and Standards-October 1986

Figure 1

CONICAL BURNER

DEPOSITION DISTRIBUTION FOR GASEOUS AND PARTICULATE EMISSIONS
(PARTICULATE SIZE LESS THAN 30 MICRON DIAMETER)

(point of maximum deposition(Dmax) is indicated by an X. The .50 Dmax and .8Dmax isopleths are indicated by .5x and and .8x respectively)

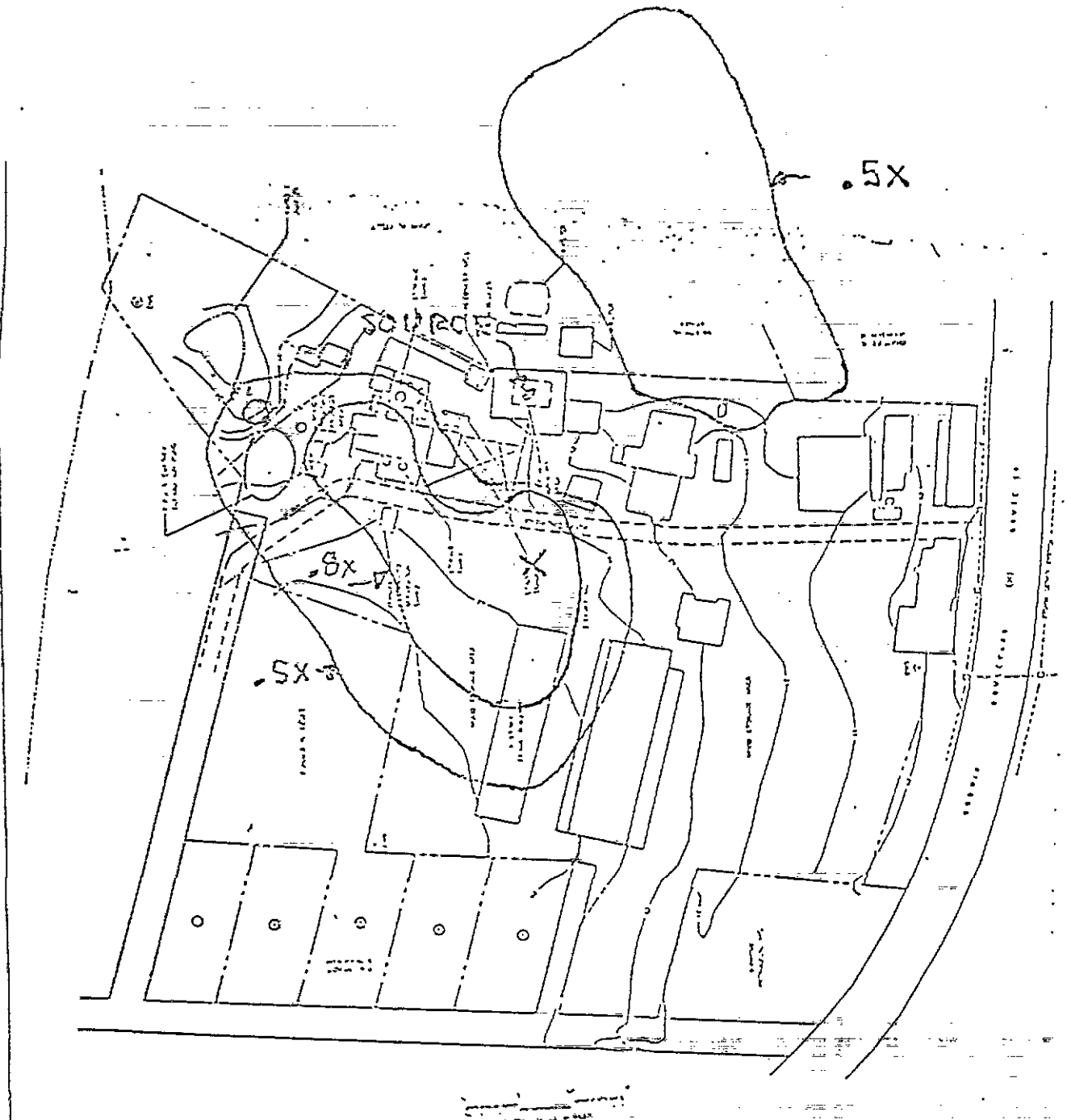


Figure 2

CONICAL BURNER

DEPOSITION DISTRIBUTION FOR A UNIFORM MIX OF PARTICULATES
40 MICRONS TO 100 MICRONS DIAMETER

(The point of maximum deposition(Dmax) is indicated by an X. The .5Dmax isopleth is indicated by .5x)

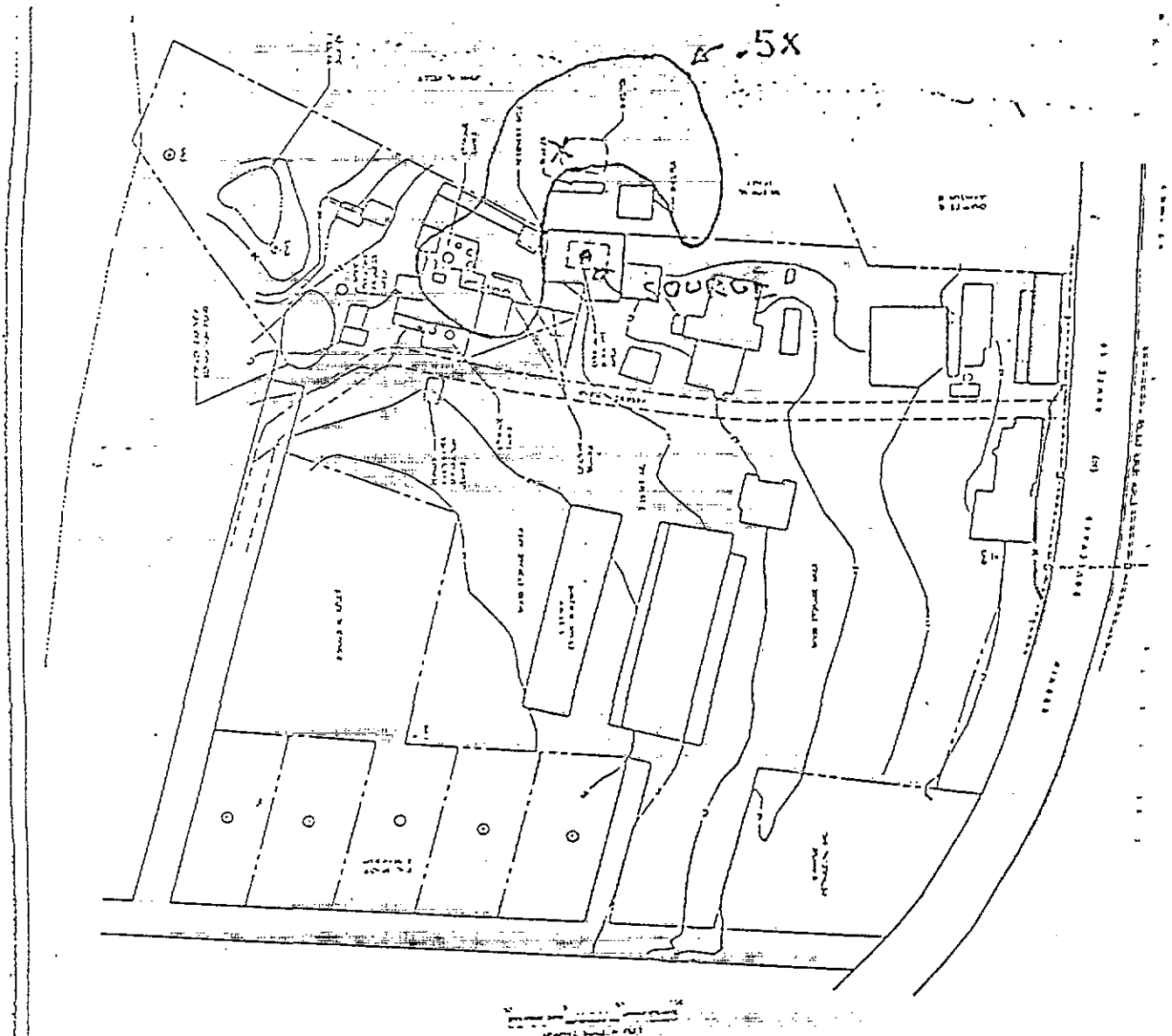


Figure 3

BASIN BURN

DEPOSITION DISTRIBUTION FOR GASEOUS AND PARTICULATE EMISSIONS
(PARTICULATE SIZE LESS THAN 30 MICRONS DIAMETER)

(point of maximum deposition(Dmax) is indicated by an X. The .50Dmax and .75Dmax isopleths are indicated by .5x and .75x respectively.)

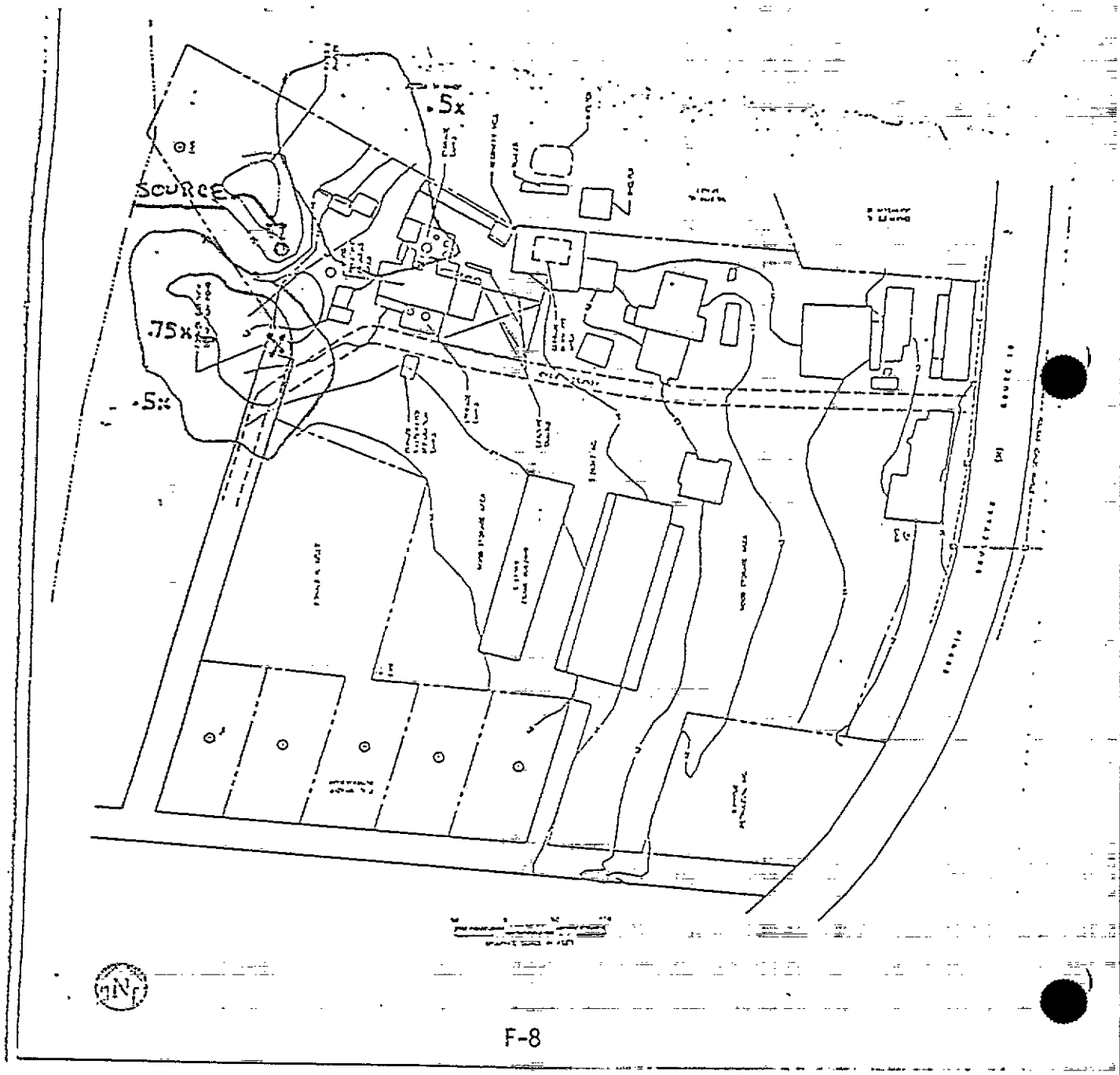
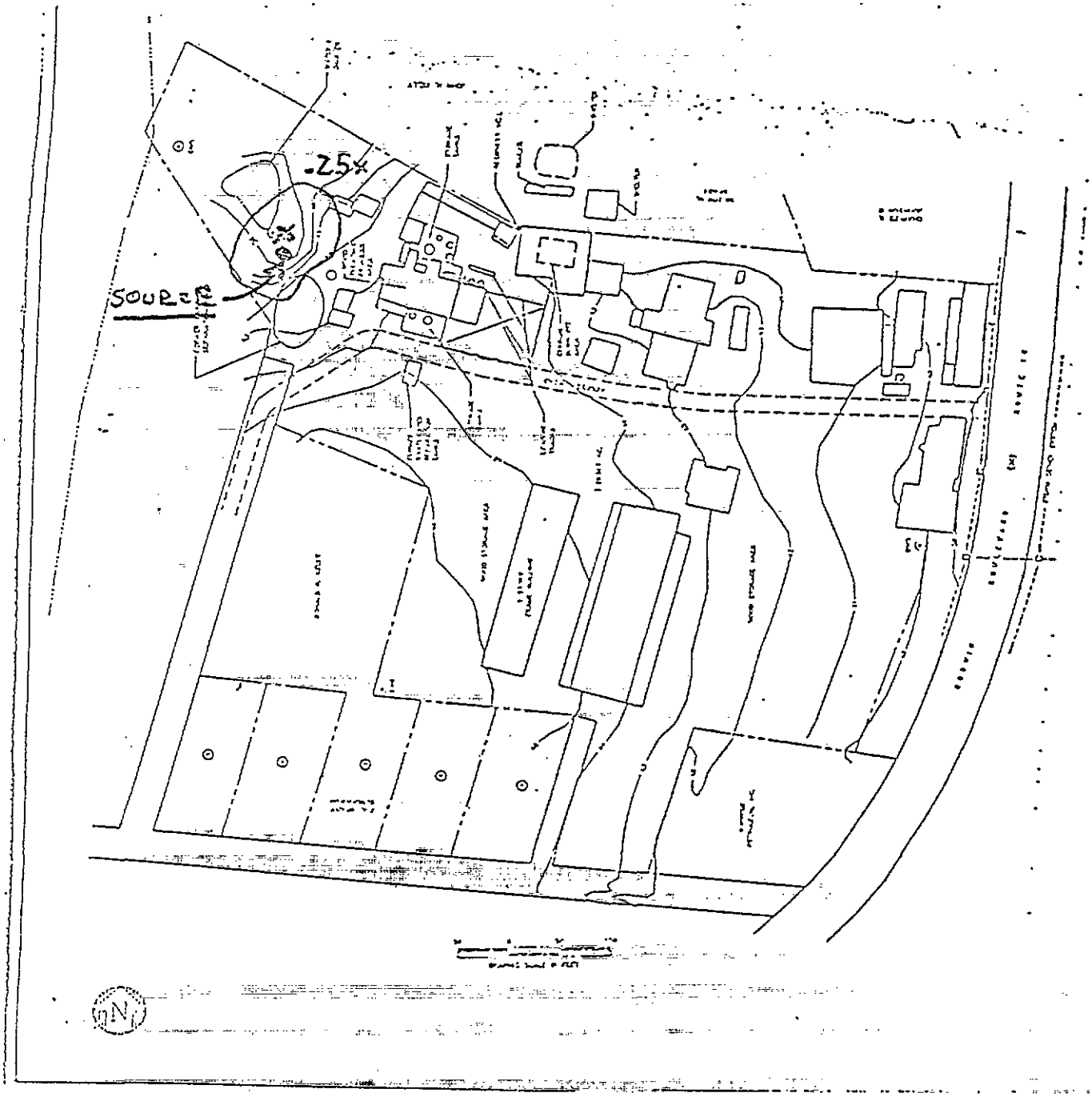


Figure 4

BASIN BURN

DEPOSITION DISTRIBUTION FOR UNIFORM MIX OF PARTICULATES
WITH DIAMETERS 40 TO 100 MICRONS

(The point of maximum deposition(Dmax is indicated by an X. The .25Dmax isopleth is indicated by .25x)



APPENDIX

ESTIMATION OF POLLUTANT DEPOSITION DISTRIBUTION DUE TO BURNING OF PENTACHLOROPHENOL(PCP) SLUDGE AT THE SSC SITE

Estimates have been made of the probable ground surface distribution of polychlorinated dibenzo-p-dioxins(PCDDs) and polychlorinated dibenzofurans (PCDFs) resulting from uncontrolled combustion of waste sludge containing pentachlorophenol(PCP) at the SSC site. Sludge was disposed of in this fashion between the years 1969 and 1974 by utilizing a conical burner unit located at the north end of the site and an settling basin located at the north-west corner of the site.

The burning of materials containing chlorophenates results in PCDD/PCDF emissions in both the particulate(by adsorption) phase and the gaseous phase (1,2,3,4,5). The dispersal and subsequent deposition of both phases would be determined primarly by the prevailing meteorological conditions at the time of the burn. PCDD/PCDFs deposited and adsorbed by the soil can be expected to persist and to remain in the top six inches of soil.(6)

To determine the probable deposition distribution pattern of PCDD/PCDFs on ground surfaces in the vicinity of the conical burner unit and the open basin, E & E has employed the use of the Industrial Source Complex Long Term (ISCLT) dispersion model(7) using the deposition option. The EPA-approved model utilizes a steady-state Gaussian plume equation to calculate ground level concentrations and deposition for stack sources and for area sources using a virtual point source approximation. To determine yearly or total deposition values the model incorporates sector-averaging and statistical wind-stability class summaries(annual averages).

Main input requirements of the ISCLT model consists of:

- o Source data
- o Receptor data
- o Meteorological data

The following listing shows all relevant input parameters for the conical burner unit and the open basin.

Source Data:

Conical Burner Unit:

Source type:	-Stack
Source Location:	-Conical burn pit area, north end of site as indicated on site facilities map, Figures 1 and 2 of report
Physical stack height:	-Approximately 10 meters(33 ft)
Stack exit temperature:	-Approximately 450 degrees Kelvin
Stack exit velocity:	-Assumed to be zero due to presence of rain cap

Stack diameter: -Approximately 1 meter(3.3 ft)
Particulate settling velocities: -Particulate sizes from less than one micron to 100 microns considered. Settling velocities corresponding to these particulate sizes were determined using Stoke's Law.(7,8)
Source Emission Rate: -Arbitrary total of 1,000 grams

Open Settling Basin:

Source type: -Area source
Source location: -North-West corner of site just NNW of pond as indicated on figures 3 & 4 of report
Source Diameter: -Approximately 5 meters(16 ft), modeled as square area of width 4.4 meters(14 ft)
Effective emission height: -Estimated to be approximately 4 meters(10)
Particulate settling velocities: -Particulate sizes from less than one micron to 100 microns considered. Settling velocities corresponding to these particulate sizes were determined using Stoke's law.(7,8)
Emission rate: -Arbitrary total emissions of 50 gm per square meter used(approximately 1,000 gm total for basin)

Receptor Data: To facilitate plotting of deposition distribution results a Cartesian coordinate system containing a total of 1681 equally spaced receptor points was chosen.

Meteorological Data: Average annual wind distribution by Pasquill stability classes (STAR program)(9), an annual mean morning atmospheric mixing height(10) of 600 meters and an annual average ambient temperature(11) of 289 degrees Kelvin for the Norfolk, Va. region were used.

All computer runs of the ISCLT program were made using the deposition option. Calculations were made for ground-level deposition values at 1681 evenly spaced receptor sites with the source located at the grid center. Initial runs using a large grid spacing indicated maximum deposition values are located within 100 meters of the source for both the conical burner and the open pool burn. Final runs were made using a grid spacing of 5 meters. All runs were made for total deposition at each receptor site using average annual meteorological data for the region.

Program inputs and assumptions:

Source emissions: Deposition levels estimated by the ISCLT program are directly proportional to total emissions(7). As a result, a change in total emissions does not affect predicted deposition profiles. Since the total amount of sludge disposed of by burning was not documented, an arbitrary total emission value for the pollutant of concern of 1000 grams(1 kg) was used for the conical burner unit and 50 grams per square meter (approximately 1 kg total for the basin) was used.

Effective emission height: The presence of a rain cap on the conical burner stack would impede plume rise, reducing the vertical component of the exhaust gasses and the effective emission height of the plume. It was assumed the exhaust gasses would be deflected horizontally producing a negligible vertical (stack exit) velocity. Under these conditions the Briggs plume rise equations predict an effective emission height equal to the physical stack height(10 m.) (7,12).
To model the basin burn as an area emission source using the ISCLT Dispersion model, the effective emission height is set by the user. A conservative estimate of the effective emission height was made by assuming the emission height to be equal to the average flame height(15,16).

Stack temperature: The temperature of the exhaust gasses was estimated to be 450 degrees Kelvin. Since this parameter was not documented a sensitivity analysis relating deposition results to stack temperature was preformed. The results of the analysis showed variations of up to 500 degrees Kelvin in this value produced no significant changes in predicted deposition levels.

Meteorological data: Since the dates of the burns were also not documented, average annual meteorological conditions were assumed to prevail. These data included the average annual frequency of occurence of wind by direction, speed and stability class, the average annual morning mixing height and the average annual ambient temperature for the Norfolk, Virginia area.

Particulate size: It was assumed emissions could contain PCDD/PCDFs in both the gaseous phase and in the particulate phase(by adsorption). Uncontrolled burning of distillate oil results in particulate emissions at the rate of two pounds per 1000 gallons oil with a majority of the particulates having diameters less than 15 microns(13). Co-firing sludge with wood wastes would increase particulate emissions. The particulate emission factor for uncontrolled burning of wood/bark is 7.2 pounds per ton with a majority of the particulates again having diameters less than 15 microns(13).

Since the distribution of PCDD/PCDF emissions as a function of particulate size was unknown, a sensitivity analysis was performed to determine the effect of particulate size on the resultant deposition distribution pattern. The results of the analysis showed the distribution pattern to be the same for the gaseous component and for particulates with diameters up to 30 microns. Distribution patterns for particulates with diameters greater than 30 microns show maximum deposition levels, as expected, nearer the source. As a result of the unknown distribution of PCDD/PCDFs within the gaseous component and the particulate

component of the plume, it was decided to determine separately the deposition distribution patterns for (1)emissions including the gaseous component and particulates with diameters less than 30 microns and (2)emissions consisting of a mixture(uniform) of particulates with diameters ranging from 30 to 100 microns.

Reflection coefficients: The reflection of gasses and particulates from ground surfaces would lower ground level deposition levels. The reflection of pollutants at ground surfaces is a function of particle size with the reflection coefficient(fraction reflected) approaching zero for particulates above 70 microns diameter(14). Since the differences in reflection coefficients between the gaseous component and particulates up to 30 microns in diameter would not change the deposition distribution pattern, a reflection coefficient of zero(no reflection) was assumed for all emissions in this range. For particulates with diameters greater than 30 microns, two separate computer runs, one assuming a reflection coefficient of zero for all particulate sizes and one utilizing reflection coefficients suggested by Dumbauld et al(14), were made. The results showed no significant difference in the corresponding deposition distribution patterns. As a result a reflection coefficient of zero was used for all particulate size catagories.

Program options-other:

1)Stack-tip downwash option:Since low exit velocity enhances stack downwash of the plume, the stack-tip downwash program option was exercised.

2)Meteorological data default options:Default options were exercised to utilize program default values for vertical potential temperature gradients, mean wind speed for wind speed catagories used, and for wind speed power law exponents since site-specific data for these parameters were not available.

3)Bouyancy induced dispersion option: Due to the negligible plume rise imposed by the raincap, the vertical and horizontal dispersion coefficients would remain unchanged(7). As a result this program option was not exercised.

Incorporating the above assumptions and program options the deposition levels at pre-determined receptor points were calculated using the ISC long term dry deposition methodology described by Wackter et. al.(7). The ISC models do not address the effect of wet deposition on pollutant concentrations and depositions. Scavanging of pollutants by rainfall however would tend to increase deposition levels for receptors nearer the source and would, if anything, move predicted maximum deposition levels nearer to the source.

Table 1 shows an example of the program input listing for the conical burner unit for the gaseous component of the emissions. Due to the length of the STAR program data, only a portion of these data is included. Table 2 shows the corresponding output of the program including deposition levels at a sample portion of the receptor sites and a printout of the location of the sites having the 10 highest predicted deposition levels. The results for all computer runs are summarized on figures 1 through 4 of the report.

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TABLE 1.

SAMPLE ISCLT PROGRAM INPUT LISTING

CONICAL TURNER UNIT - SRC SITE - GASEOUS EMISSIONS

```
ISCLT (DATED 87032)
AN AIR QUALITY DISPERSION MODEL FOR
SECTION 1.  GUIDELINE MODELS
P" UNAMAP (VERSION 6) JAN. 88.
SOURCE:  FILE 7 ON UNAMAP MAGNETIC TAPE FROM NTIS.

** ISCLT INPUT DATA - GENERAL

  NUMBER OF SOURCES =   1
  NUMBER OF X AXIS GRID SYSTEM RECEPTORS =   41
  NUMBER OF Y AXIS GRID SYSTEM RECEPTORS =   41
  NUMBER OF SPECIAL RECEPTORS =    0
  NUMBER OF SEASONS =   1
  NUMBER OF WIND SPEED CLASSES =   6
  NUMBER OF STABILITY CLASSES =   6
  NUMBER OF WIND DIRECTION CLASSES =  16
  FILE NUMBER OF DATA FILE USED FOR REPORTS =   1
  THE PROGRAM IS RUN IN RURAL MODE
  CONCENTRATION (DEPOSITION) UNITS CONVERSION FACTOR =0.10000000E+01
  ACCELERATION OF GRAVITY (METERS/SECOND2) =  9.800
  HEIGHT OF MEASUREMENT OF WIND SPEED (METERS) =  10.000
  CORRECTION ANGLE FOR GRID SYSTEM VERSUS DIRECTION DATA NORTH (DEGREES) =   0.000
  DECAY COEFFICIENT =0.00000000E+00

OPTIONAL OPTIONS SELECTED:

  IOPT( 1)= 2:  calculate deposition
  IOPT( 2)= 1:  Cartesian coord. receptor grid
  IOPT( 3)= 1:  Cartesian discrete receptors
  IOPT( 4)= 0:  no terrain elevations
  IOPT( 5)= 0:  no input or output tape
  IOPT( 6)= 0:  print all input data
  IOPT( 7)= 0:  print annual results only
  IOPT( 8)= 2:  print only combined sources
  IOPT( 9)= 3:  Rural mode
  IOPT(10)= 2:  print both max. 10 and all others
  IOPT(11)= 1:  max. 10 sources and combs. independent
  IOPT(12)= 0:
  IOPT(13)= 0:  print output logical unit no. 6
  IOPT(14)= 0:  tape input logical unit no. 2
  IOPT(15)= 0:  tape output logical unit no. 3
  IOPT(16)= 1:  program minimizes no. of output pages
  IOPT(17)= 0:  57 lines per page
  IOPT(18)= 0:  default format for reading STAR data: 6F10.0
  IOPT(19)= 0:  final plume rise
  IOPT(20)= 1:  Briggs stack-tip downwash
  IOPT(21)= 1:  no buoyancy-induced dispersion
  IOPT(22)= 1:  regulatory default mode not used
  IOPT(23)= 1:  pollutant other than SO2
  IOPT(24)= 1:  no immediate echo printout of input data
  IOPT(25)= 0:  no receptor heights input

SOURCE DATA: CONICAL BURNER UNIT LOCATED AT (0,0)

DISTANCE X AXIS GRID SYSTEM POINTS (METERS )=   -100.00,    -95.00,    -90.00,    -85.00,    -80.00,    -75.00,
     -70.00,    -65.00,    -60.00,    -55.00,    -50.00,    -45.00,    -40.00,    -35.00,    -30.00,    -25.00,
```

-20.00,	-15.00,	-10.00,	-5.00,	0.00,	5.00,	10.00,	15.00,	20.00,	25.00,
30.00,	35.00,	40.00,	45.00,	50.00,	55.00,	60.00,	65.00,	70.00,	75.00,
80.00,	85.00,	90.00,	95.00,	100.00,					
LONGITUDINAL AXIS GRID SYSTEM ORIGIN (METERS)=					-100.00,	-95.00,	-90.00,	-85.00,	-80.00,	-75.00,
-70.00,	-65.00,	-60.00,	-55.00,	-50.00,	-45.00,	-40.00,	-35.00,	-30.00,	-25.00,
-20.00,	-15.00,	-10.00,	-5.00,	0.00,	5.00,	10.00,	15.00,	20.00,	25.00,
30.00,	35.00,	40.00,	45.00,	50.00,	55.00,	60.00,	65.00,	70.00,	75.00,
80.00,	85.00,	90.00,	95.00,	100.00,					

4)METEOROLOGICAL DATA:

AMBIENT AIR TEMPERATURE (DEGREES KELVIN): 293.00
MIXING LAYER HEIGHT (METERS): 800.00

FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY - SAMPLE PORTION OF LISTING
ANNUAL AVERAGE
STABILITY CATEGORY 1

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (1.50 m/s)	WIND SPEED CATEGORY 2 (2.50 m/s)	WIND SPEED CATEGORY 3 (4.30 m/s)	WIND SPEED CATEGORY 4 (6.50 m/s)	WIND SPEED CATEGORY 5 (9.50 m/s)	WIND SPEED CATEGORY 6 (12.50 m/s)
0.00	0.000871	0.000902	0.000000	0.000000	0.000000	0.000000
22.50	0.000546	0.000731	0.000000	0.000000	0.000000	0.000000
45.00	0.000354	0.000445	0.000000	0.000000	0.000000	0.000000
67.50	0.000392	0.000502	0.000000	0.000000	0.000000	0.000000
90.00	0.000322	0.000274	0.000000	0.000000	0.000000	0.000000
112.50	0.000045	0.000060	0.000000	0.000000	0.000000	0.000000
135.00	0.000021	0.000011	0.000000	0.000000	0.000000	0.000000
157.50	0.000107	0.000081	0.000000	0.000000	0.000000	0.000000
180.00	0.000172	0.000126	0.000000	0.000000	0.000000	0.000000
202.50	0.000161	0.000139	0.000000	0.000000	0.000000	0.000000
225.00	0.000160	0.000400	0.000000	0.000000	0.000000	0.000000
247.50	0.000315	0.000479	0.000000	0.000000	0.000000	0.000000
270.00	0.000447	0.000616	0.000000	0.000000	0.000000	0.000000
292.50	0.000158	0.000180	0.000000	0.000000	0.000000	0.000000
315.00	0.000119	0.000080	0.000000	0.000000	0.000000	0.000000
337.50	0.000209	0.000150	0.000000	0.000000	0.000000	0.000000

VERTICAL POTENTIAL TEMPERATURE GRADIENT (DEGREES KELVIN/METER) - PROGRAM DEFAULT VALUES

	WIND SPEED CATEGORY 1	WIND SPEED CATEGORY 2	WIND SPEED CATEGORY 3	WIND SPEED CATEGORY 4	WIND SPEED CATEGORY 5	WIND SPEED CATEGORY 6
STABILITY CATEGORY 1	0.000	0.000	0.000	0.000	0.000	0.000
STABILITY CATEGORY 2	0.000	0.000	0.000	0.000	0.000	0.000
STABILITY CATEGORY 3	0.000	0.000	0.000	0.000	0.000	0.000
STABILITY CATEGORY 4	0.000	0.000	0.000	0.000	0.000	0.000
STABILITY CATEGORY 5	0.020	0.020	0.020	0.020	0.020	0.020
STABILITY CATEGORY 6	0.035	0.035	0.035	0.035	0.035	0.035

WIND PROFILE POWER LAW EXPONENTS - PROGRAM DEFAULT VALUES

	WIND SPEED CATEGORY 1	WIND SPEED CATEGORY 2	WIND SPEED CATEGORY 3	WIND SPEED CATEGORY 4	WIND SPEED CATEGORY 5	WIND SPEED CATEGORY 6
STABILITY CATEGORY 1	0.07	0.07	0.07	0.07	0.07	0.07
STABILITY CATEGORY 2	0.07	0.07	0.07	0.07	0.07	0.07
STABILITY CATEGORY 3	0.10	0.10	0.10	0.10	0.10	0.10
STABILITY CATEGORY 4	0.15	0.15	0.15	0.15	0.15	0.15
STABILITY CATEGORY 5	0.35	0.35	0.35	0.35	0.35	0.35

STABILITY CATEGORY 6 0.00 0.55 0.[illegible] 0.55 0.55 0.55

DISCRETE INPUT DATA - CONICAL BURNER UNIT - GASEOUS COMPONENT

SOURCE NUMBER	SOURCE TYPE	X COORDINATE (M)	Y COORDINATE (M)	EMISSION HEIGHT (M)	BASE / ELEV- / ATION / (M) /	- SOURCE DETAILS DEPENDING ON TYPE -
X	1	STACK	0.00	0.00	10.00	0.00 GAS EXIT TEMP (DEG K)= 450.00, GAS EXIT VEL. (M/SEC)= 0.00, STACK DIAMETER (M)= 1.000, HEIGHT OF ASSO. BLDG. (M)= 0.00, WIDTH OF ASSO. BLDG. (M)= 0.00, WAKE EFFECTS FLAG = 0

- PARTICULATE CATEGORIES -
GASEOUS COMPONENT
FALL VELOCITY (m/s) 0.00
MASS FRACTION 1.000
REFLECTION COEFFICIENT 0.000
- SOURCE STRENGTHS (1.000000E+03 GRAMS)

TABLE 2
SAMPLE ISCLT PROGRAM OUTPUT
CONICAL BURNER UNIT -SSC SITE - GASEOUS COMPONENT

ANNUAL GROUND LEVEL DEPOSITION (GRAMS PER SQUARE METER)
- GRID SYSTEM RECEPTORS -
- X AXIS (DISTANCE, METERS) -

Y AXIS (DISTANCE , METERS)	-100.000	-95.000	-90.000	-85.000	-80.000	-75.000	-70.000	-65.000	-60.000
				- DEPOSITION -					
100.000	0.5128E-03	0.6485E-03	0.6901E-03	0.7130E-03	0.7491E-03	0.7859E-03	0.8269E-03	0.8603E-03	0.9140E-03
95.000	0.5259E-03	0.6549E-03	0.6988E-03	0.7238E-03	0.7559E-03	0.7954E-03	0.8363E-03	0.8797E-03	0.9282E-03
90.000	0.6324E-03	0.6634E-03	0.6988E-03	0.7280E-03	0.7645E-03	0.8035E-03	0.8450E-03	0.8893E-03	0.9382E-03
85.000	0.6383E-03	0.6693E-03	0.7017E-03	0.7319E-03	0.7722E-03	0.8114E-03	0.8532E-03	0.8976E-03	0.9454E-03
80.000	0.6436E-03	0.6755E-03	0.7089E-03	0.7438E-03	0.7804E-03	0.8194E-03	0.8611E-03	0.9070E-03	0.9585E-03
75.000	0.6485E-03	0.6812E-03	0.7155E-03	0.7512E-03	0.7888E-03	0.8281E-03	0.8696E-03	0.9180E-03	0.9645E-03
70.000	0.5529E-03	0.6863E-03	0.7213E-03	0.7580E-03	0.7962E-03	0.8365E-03	0.8823E-03	0.9252E-03	0.9697E-03
65.000	0.5570E-03	0.6910E-03	0.7257E-03	0.7638E-03	0.8035E-03	0.8477E-03	0.8897E-03	0.9333E-03	0.9745E-03
60.000	0.6610E-03	0.6955E-03	0.7318E-03	0.7696E-03	0.8102E-03	0.8538E-03	0.8942E-03	0.9360E-03	0.9807E-03
55.000	0.6649E-03	0.6999E-03	0.7362E-03	0.7750E-03	0.8170E-03	0.8566E-03	0.8956E-03	0.9374E-03	0.9784E-03
50.000	0.6693E-03	0.7046E-03	0.7405E-03	0.7809E-03	0.8212E-03	0.8607E-03	0.9000E-03	0.9396E-03	0.9724E-03
45.000	0.6742E-03	0.7105E-03	0.7473E-03	0.7882E-03	0.8283E-03	0.8629E-03	0.8986E-03	0.9324E-03	0.9607E-03
40.000	0.7220E-03	0.7166E-03	0.7575E-03	0.7949E-03	0.8317E-03	0.8671E-03	0.9001E-03	0.9295E-03	0.9544E-03
35.000	0.8841E-03	0.8711E-03	0.8504E-03	0.8122E-03	0.8403E-03	0.8711E-03	0.9044E-03	0.9292E-03	0.9474E-03
30.000	0.1060E-02	0.1066E-02	0.1039E-02	0.1038E-02	0.9994E-03	0.9404E-03	0.9138E-03	0.9347E-03	0.9456E-03
25.000	0.1242E-02	0.1273E-02	0.1287E-02	0.1288E-02	0.1271E-02	0.1203E-02	0.1169E-02	0.1074E-02	0.9563E-03
20.000	0.1445E-02	0.1493E-02	0.1531E-02	0.1550E-02	0.1577E-02	0.1560E-02	0.1524E-02	0.1455E-02	0.1347E-02
15.000	0.1552E-02	0.1703E-02	0.1788E-02	0.1846E-02	0.1891E-02	0.1910E-02	0.1919E-02	0.1888E-02	0.1816E-02

[illegible]	0.1991E-02	[illegible]	[illegible]	0.2146E-02	[illegible]	0.2309E-02	0.2345E-02	0.2363E-02	0.2341E-02
0.000	0.2070E-02	0.2191E-02	[illegible]	0.2454E-02	0.2574E-02	0.2698E-02	0.2798E-02	0.2864E-02	0.2905E-02
0.000	0.2276E-02	0.2428E-02	0.2507E-02	0.2751E-02	0.2917E-02	0.3072E-02	0.3233E-02	0.3369E-02	0.3477E-02
-5.000	0.2290E-02	0.2438E-02	0.2591E-02	0.2755E-02	0.2921E-02	0.3083E-02	0.3237E-02	0.3373E-02	0.3483E-02
-10.000	0.2299E-02	0.2439E-02	0.2594E-02	0.2760E-02	0.2920E-02	0.3095E-02	0.3255E-02	0.3401E-02	0.3525E-02
-15.000	0.2277E-02	0.2431E-02	0.2594E-02	0.2763E-02	0.2936E-02	0.3111E-02	0.3281E-02	0.3444E-02	0.3592E-02
-20.000	0.2251E-02	0.2425E-02	0.2590E-02	0.2763E-02	0.2943E-02	0.3127E-02	0.3312E-02	0.3495E-02	0.3672E-02
-25.000	0.2241E-02	0.2414E-02	0.2581E-02	0.2758E-02	0.2945E-02	0.3139E-02	0.3340E-02	0.3546E-02	0.3745E-02
-30.000	0.2223E-02	0.2397E-02	0.2566E-02	0.2747E-02	0.2940E-02	0.3145E-02	0.3353E-02	0.3448E-02	0.3541E-02
-35.000	0.2200E-02	0.2359E-02	0.2544E-02	0.2730E-02	0.2930E-02	0.3033E-02	0.3169E-02	0.3304E-02	0.3375E-02
-40.000	0.2171E-02	0.2321E-02	0.2479E-02	0.2603E-02	0.2766E-02	0.2904E-02	0.3032E-02	0.3145E-02	0.3237E-02
-45.000	0.2100E-02	0.2239E-02	0.2370E-02	0.2521E-02	0.2656E-02	0.2787E-02	0.2910E-02	0.3022E-02	0.3119E-02
-50.000	0.2037E-02	0.2158E-02	0.2286E-02	0.2425E-02	0.2553E-02	0.2670E-02	0.2798E-02	0.2910E-02	0.3013E-02
-55.000	0.1966E-02	0.2081E-02	0.2199E-02	0.2333E-02	0.2454E-02	0.2574E-02	0.2692E-02	0.2804E-02	0.2919E-02
-60.000	0.1897E-02	0.2005E-02	0.2116E-02	0.2230E-02	0.2358E-02	0.2474E-02	0.2588E-02	0.2700E-02	0.2816E-02
-65.000	0.1829E-02	0.1931E-02	0.2036E-02	0.2145E-02	0.2256E-02	0.2376E-02	0.2487E-02	0.2597E-02	0.2771E-02
-70.000	0.1762E-02	0.1857E-02	0.1956E-02	0.2058E-02	0.2161E-02	0.2260E-02	0.2384E-02	0.2551E-02	0.2726E-02
-75.000	0.1695E-02	0.1785E-02	0.1878E-02	0.1972E-02	0.2072E-02	0.2172E-02	0.2326E-02	0.2500E-02	0.2674E-02
-80.000	0.1630E-02	0.1714E-02	0.1801E-02	0.1891E-02	0.1983E-02	0.2123E-02	0.2272E-02	0.2434E-02	0.2612E-02
-85.000	0.1566E-02	0.1644E-02	0.1720E-02	0.1808E-02	0.1930E-02	0.2071E-02	0.2215E-02	0.2367E-02	0.2530E-02
-90.000	0.1502E-02	0.1575E-02	0.1651E-02	0.1765E-02	0.1886E-02	0.2015E-02	0.2152E-02	0.2298E-02	0.2452E-02
-95.000	0.1440E-02	0.1508E-02	0.1610E-02	0.1718E-02	0.1833E-02	0.1956E-02	0.2085E-02	0.2223E-02	0.2368E-02
-100.000	0.1379E-02	0.1470E-02	0.1566E-02	0.1669E-02	0.1779E-02	0.1893E-02	0.2015E-02	0.2144E-02	0.2279E-02

- PROGRAM DETERMINED MAXIMUM 10 VALUES -

X COORDINATE (METERS)	Y COORDINATE (METERS)	DEPOSITION
0.00	-55.00	0.004848
0.00	-50.00	0.004827
0.00	-60.00	0.004823
0.00	-45.00	0.004759
0.00	-65.00	0.004740
-5.00	-60.00	0.004622
-5.00	-55.00	0.004617
0.00	-40.00	0.004613
0.00	-70.00	0.004610
-5.00	-65.00	0.004569

APPENDIX G

SLUG TEST DATA

ESTIMATED AQUIFER CHARACTERISTICS*

Location	Gradient	Estimated Porosity	Hydraulic Conductivity (feet/day)	Groundwater Flow Velocity (feet/day)
Shallow Wells				
MW-3-S	0.027	0.25	0.205	2.21×10^{-2}
MW-4-S	0.045	0.25	0.045	8.10×10^{-3}
MW-5-S	0.014	0.25	0.250	1.40×10^{-2}
MW-7-S	0.023	0.25	0.098	9.02×10^{-3}
MW-11-S	0.028	0.25	3.520	3.94×10^{-1}
MW-13-S	0.012	0.25	0.273	1.31×10^{-2}
Deep Wells				
MW-2-D	0.018	0.25	0.0094	6.48×10^{-4}
MW-6-D	0.015	0.25	3.75	2.25×10^{-1}
MW-10-D	0.017	0.25	0.02	1.36×10^{-3}
MW-14-D	0.013	0.25	0.16	8.32×10^{-3}

02[UZ]ZD3081:D3123/4273/27

Key:

*Gradient: obtained from Figures 4-7 through 4-10
Estimated Porosity: based on soil logging information
Hydraulic Conductivity: measured through slug tests
Groundwater Flow Velocity: calculated

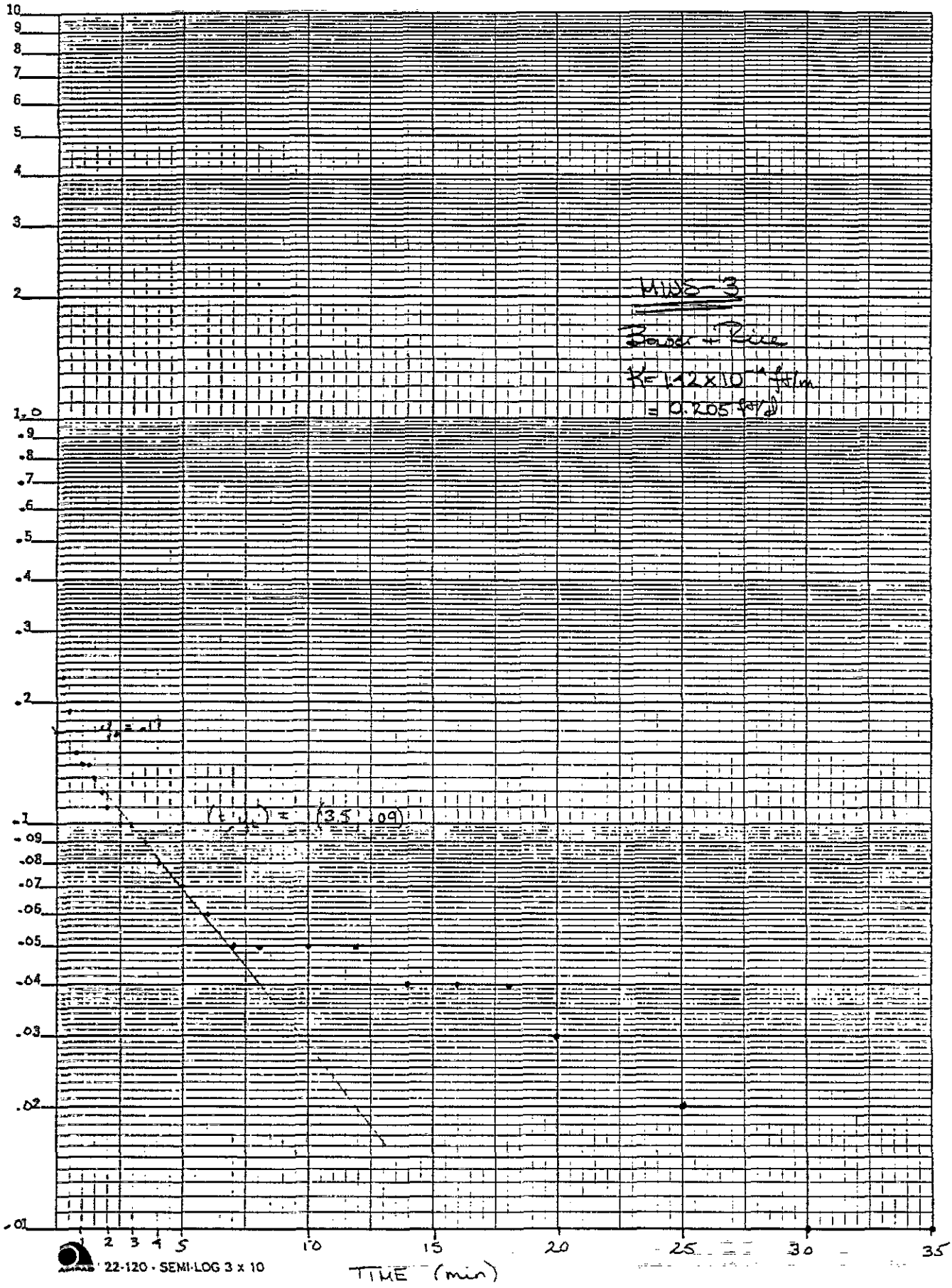
Source: Ecology and Environment, Inc., 1991.

SLUG TEST DATA - SUMMARY

	Slug Injection / Falling Head				Slug Withdrawal / Rising Head		
	Max Rise Δh	Residual Δh	Time to Recover (min)	K (ft/d) Bouwer-Rice	Max Fall Δh	Peak Δh	Time to Recover (min)
MW-3	0.23'	0.0'	20	0.205	1.69'	0.0'	8
MW-4	0.93'	0.67'	DOESN'T	0.045	0.11'	0.0'	1½
MW-5	0.52'	0.10'	20	0.250	0.61'	above SWL 0.08'	6 (to static)
MW-7	1.39'	0.05'	7	0.098	1.15'	above SWL 0.10'	4½ (to static)
MW-11	0.46'	0.00'	1½	3.52	0.37'	0.0'	2½
MW-13	0.66'	0.01'	15	0.273	0.49'	0.09'	5
				K (ft/day) Cooper B&R			(ft/day) Cooper
MWD-2	2.67'	1.17'	DOESN'T	0.009 .008	0.91'	above SWL 0.60	18 (to static)
MWD-6	1.30'	0.04'	20	3.75 .393	1.74'	0.0	8 2.98
MWD-10	2.00'	0.53'	DOESN'T	0.02 .024	— NO TEST —		
MWD-14	2.14'	0.07'	105	0.06 .038 *	4.63	0.02	55

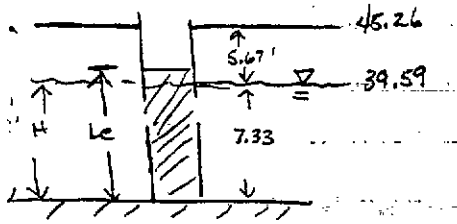
* Well is underdeveloped.

SHALLOW WELLS


MW-3
Bouwer + Rice
K = 1.12 x 10⁻¹ ft/min
= 0.205 ft/d
y_t = Δh (feet)
(t, y_t) = (3.5, .09)
TIME (min)
22-120 · SEMI-LOG 3 x 10

MWS-3

Bower + Rice



$r_c = .08'$ $r_w = .90'$ $L_e = 9'$ (use log screen length) $H = 7.33$

t	h	Δh	t	h	Δh
—	39.59 = SWL	0	25	39.61	0.02
0.25	39.82	0.23'	30	39.60	0.01
0.50	39.78	0.19	35	39.60	0.01
0.75	39.74	0.15	40	39.59	0.0
1.00	39.73	0.14			
1.25	39.73	0.14			
1.50	39.72	0.13			
1.75	39.71	0.12			
2.0	39.70	0.11			
2.5	39.69	0.10			
3.0	39.69	0.10			
3.5	39.68	0.09			
4.0	39.67	0.08			
5	39.66	0.07			
6	39.65	0.06			
7	39.64	0.05			
8	39.64	0.05			
10	39.64	0.05			
12	39.64	0.05			
14	39.63	0.04			
16	39.63	0.04			
18	39.63	0.04			
20	39.62	0.03			

$L_e/r_w = 9/.9 = 22.5 \Rightarrow C = 1.7$

$y_o = 0.17'$

$(t, y_t) = (3.5, .09)$

$$\left[\ln\left(R_e/r_w\right)\right] = \left(\frac{1.1}{\ln(7.33/.9)} + \frac{1.7}{22.5}\right)^{-1}$$

$$= (.378 + .076)^{-1} = 2.20$$

$$K = \frac{(.08)^2\,[2.20]\ ft^2}{2.9\ ft} \cdot \frac{1}{3.5\ min} \ln\frac{0.17}{0.09} = \boxed{1.42 \times 10^{-4}\ ft/min}$$

7.84×10^{-4} · 1.82×10^{-1}

$K = 2.05 \times 10^{-1}\ ft/d$

$= 1.54\ gpd/ft^2$

Slug test data

Site : SSC Job No. : ZD3032 Well NO :HWS-3

Date:Oct.24,89 Static : 5.48 To.Dept: 11.13 top of pv

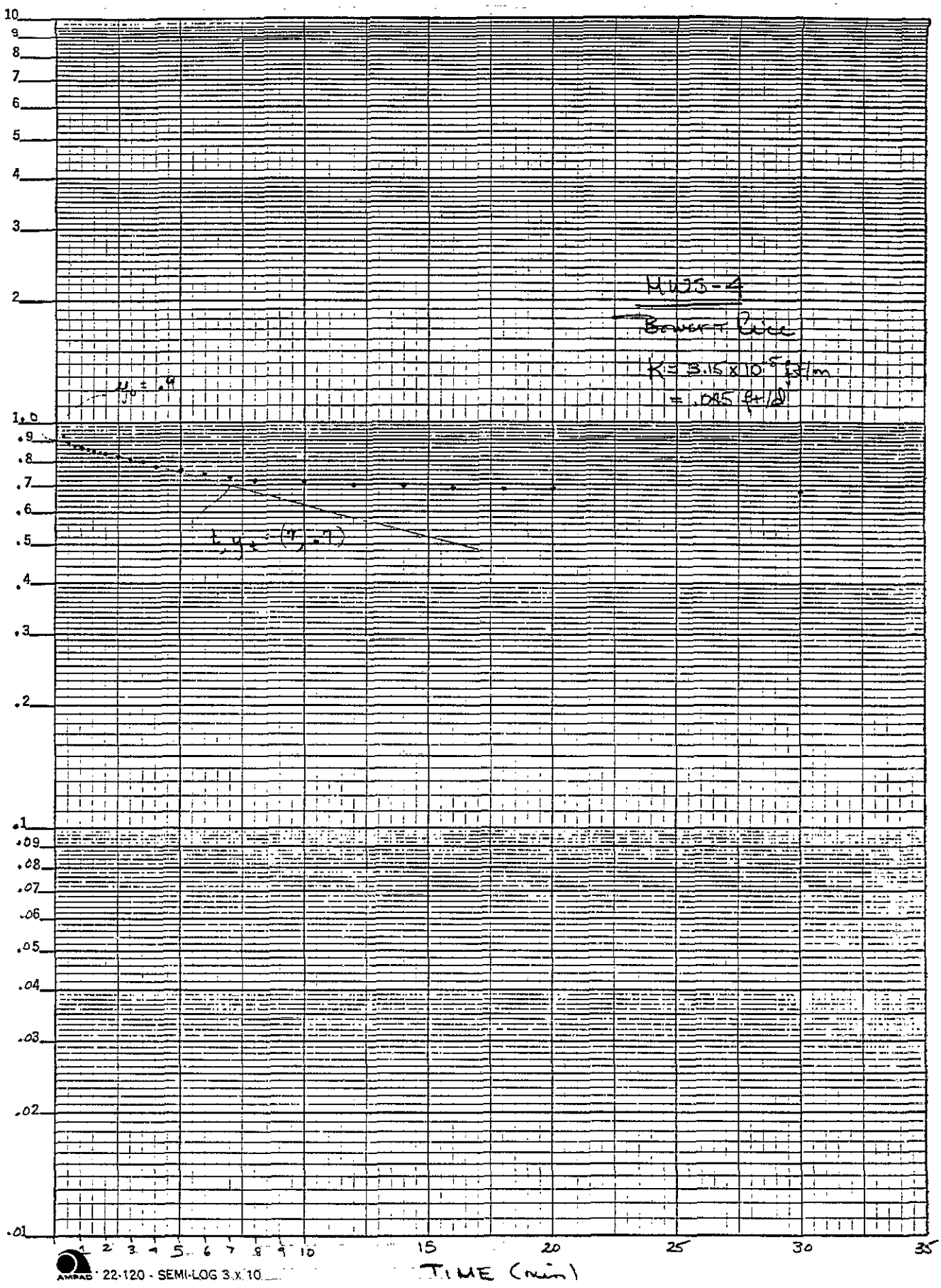
TOC Elev = 45.07'
Surf Elev = 45.26'
Static WL = 39.59'
(TOC - 5.48')

c

TIME	LAPS TIME IN MIN	DEPTH TO WATER IN FT FALGN. HEAD	WATER ELVATN	TIME	LAPS TIME IN MIN	DEPTH TO WATER IN FT RISIGN HEAD	WATER ELVATN.	REMARKS
1023	0.25	5.25	39.82	1103	0.25	7.17	37.9	Reference for
	0.5	5.29	39.78		0.5	6.17	38.9	level readings
	0.75	5.33	39.74		0.75	5.71	39.36	is the top
	1	5.34	39.73		1	5.67	39.4	of PVC casing
	1.25	5.34	39.73		1.25	5.63	39.44	
	1.5	5.35	39.72		1.5	5.58	39.49	
	1.75	5.36	39.71		1.75	5.57	39.5	
	2	5.37	39.7		2	5.54	39.53	
	2.5	5.38	39.69		2.5	5.52	39.55	
	3	5.38	39.69		3	5.51	39.56	
	3.5	5.39	39.68		3.5	5.5	39.57	
	4	5.4	39.67		4	5.49	39.58	
	5	5.41	39.66		5	5.48	39.59	
	6	5.42	39.65		6	5.48	39.59	
	7	5.43	39.64		7	5.48	39.59	
1031	8	5.43	39.64		8	5.48	39.59	
	10	5.43	39.64		10			
1035	12	5.43	39.64		12			
	14	5.44	39.63		14			
1039	16	5.44	39.63		16			
	18	5.44	39.63		18			
1043	20	5.45	39.62		20			
1048	25	5.46	39.61		25			
	30	5.47	39.6		30			
1058	35	5.47	39.6		35			
1103	40	5.48	39.59		40			
	45				45			
	50				50			
	55				55			
	60				60			
	70				70			
	80				80			
	90				90			

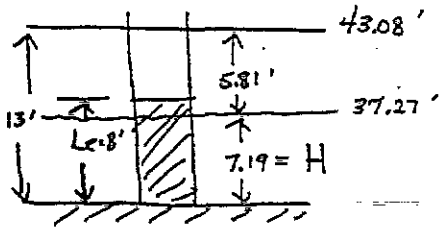
G-8

HB301788



MW5-4

Bower + Rice



$r_c = .08'$ $L_e = 8'$

$r_w = .40'$ $H = 7.19$

t	h	Δh
0	37.27	SWL
.25	38.20	0.93'
.50	38.16	0.89
.75	38.14	0.87
1.00	38.14	0.87
1.25	38.13	0.86
1.50	38.12	0.85
1.75	38.12	0.85
2.0	38.11	0.84
2.5	38.10	0.83
3.0	38.08	0.81
3.5	38.07	0.80
4.0	38.05	0.78
5	38.03	0.76
6	38.02	0.75
7	38.00	0.73
8	37.99	0.72
10	37.98	0.71
12	37.97	0.70
14	37.97	0.70
16	37.96	0.69
18	↓	↓
20	↓	↓

t	h	Δh
25	37.96	0.69'
30	37.95	0.68'
35	37.94	
40	37.94	0.67'

DIDN'T GET BACK TO STATIC.

$L_e/r_w = 8/.4 = 20 \Rightarrow C = 1.5$

$y_0 = .9$

$t, y_t = (7, .7)$

$$\left[\ln \frac{R_e}{r_w}\right] = \left(\frac{1.1}{\ln(7.19/.4)} + \frac{1.5}{20}\right)^{-1}$$

$$= (0.38 + 0.08)^{-1} = 2.19$$

$$K = \frac{(.08)^2[2.19]}{2 \cdot 8} \cdot \frac{1}{7} \ln \frac{0.9}{0.7} = \boxed{3.15 \times 10^{-5} \text{ ft/min}}$$

$$(8.76 \times 10^{-4}) \cdot (.036)$$

$K = 4.54 \times 10^{-2}$ ft/d

$= 3.39 \times 10^{-1}$ gpd/ft²

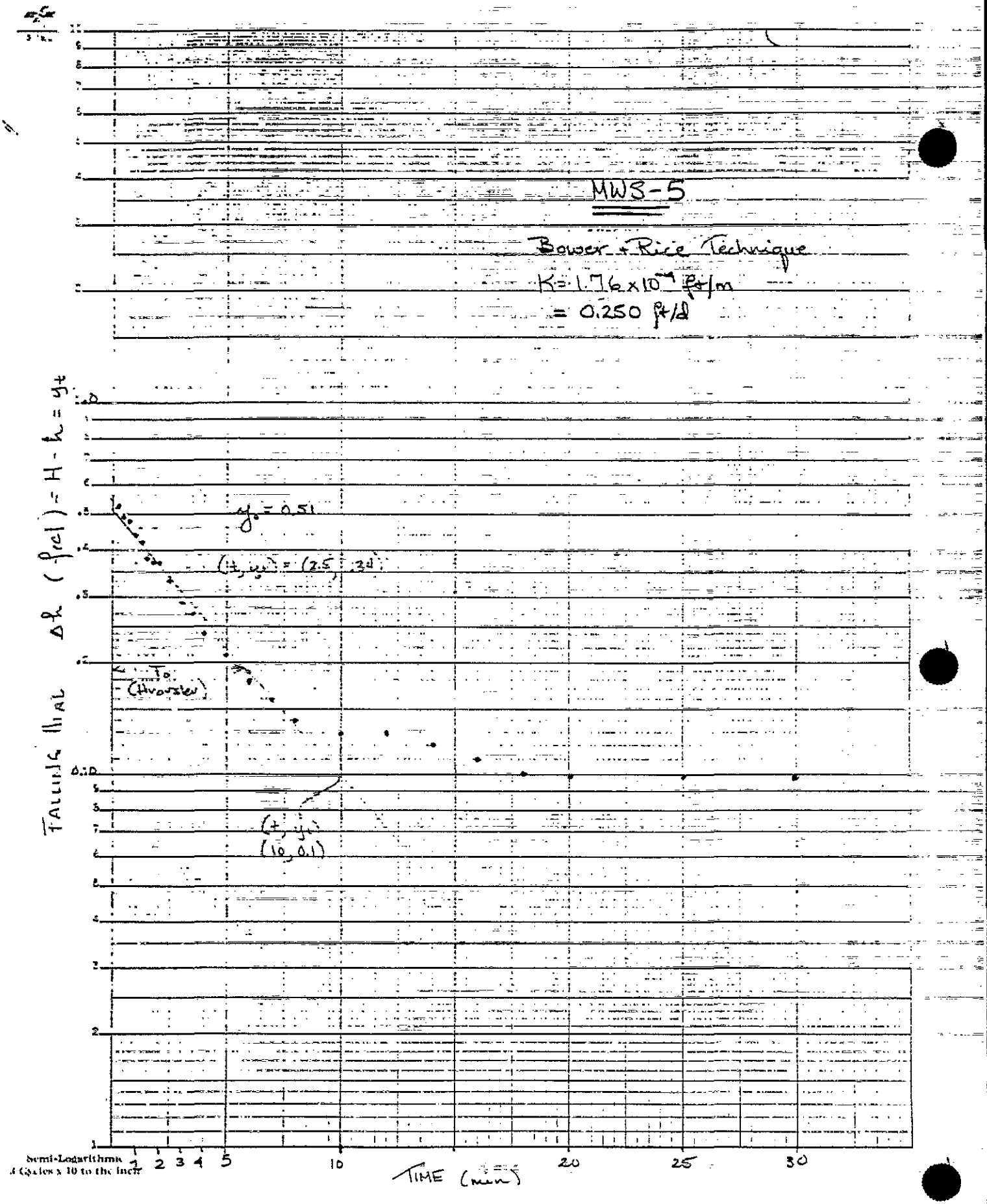
Slug test data

Site : SSC Job No. : ZD3032 Well NO :MWS-4

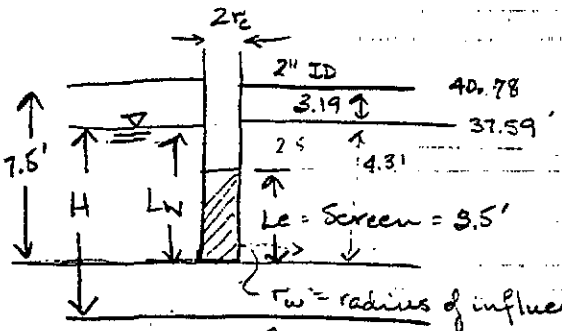
Date:Oct.24,89 Static : 5.43 To.Dept: 10.54 top of pv

Toc Elev = 42.70'
Surf Elev = 43.08'
Static WL = 37.27
(Toc - 5.43')

TIME	LAPS TIME IN MIN	DEPTH TO WATER IN FT FALGN. HEAD	WATER ELVATN	TIME	LAPS TIME IN MIN	DEPTH TO WATER IN FT RISIGN HEAD	WATER ELVATN	REMARKS
								only drop 1.3"
858	0.25	4.5	38.2	1009	0.25	5.54	37.16	Reference for
	0.5	4.54	38.16		0.5	5.55	37.15	level readings
	0.75	4.56	38.14		0.75	5.54	37.16	is the top
	1	4.56	38.14		1	5.46	37.24	of PVC casing
	1.25	4.57	38.13		1.25	5.46	37.24	
	1.5	4.58	38.12		1.5	5.43	37.27	
	1.75	4.58	38.12		1.75			
	2	4.59	38.11		2			
	2.5	4.6	38.1		2.5			
	3	4.62	38.08		3			
	3.5	4.63	38.07		3.5			
	4	4.65	38.05		4			
	5	4.67	38.03		5			
	6	4.68	38.02		6			
	7	4.7	38		7			
	8	4.71	37.99		8			
	10	4.72	37.98		10			
	12	4.73	37.97		12			
	14	4.73	37.97		14			
	16	4.74	37.96		16			
	18	4.74	37.96		18			
918	20	4.74	37.96		20			
923	25	4.74	37.96		25			
	30	4.75	37.95		30			
933	35	4.76	37.94		35			
938	40	4.76	37.94		40			
948	45	4.76	37.94		45			
958	50	4.76	37.94		50			
1008	55	4.76	37.94		55			
	60	4.76	37.94		60			
	70	4.76	37.94		70			
	80				80			
	90				90			
	105				105			


MW3-5
Bower + Rice Technique
K = 1.76 x 10⁻³ ft/m
= 0.250 ft/d
FALLING HEAD Δl (feet) = H - h = y_t
y_o = 0.51
(t, y_t) = (2.5, 3d)
To (Hvorslev)
(t, y_t)
(10, 0.1)
TIME (min)
Semi-Logarithmic (Cycles x 10 to the inch)

Bower + Rice



{assume 8-10" hole
r_w = 4"-5" = 0.4'

MWS-5

r_c = .1" = .08'

$r_w = r_c + r_g$ = 0.4'

Le = 3.5

Lw = H = 4.31' fully penetrating

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2Le} \frac{1}{t} \ln \frac{y_o}{y_t}$$

MWS-5

SWL = 37.59' elev.

t (min)	h	Δh	t	h	Δh
0	37.59	0	14	37.71	.12
.25	38.11	.52'	16	37.70	.11
.50	38.08	.49'	18	37.69	.10
.75	38.07	.48	20		
1.0	38.03	.44	25		
1.25	38.01	.42	30		
1.5	37.97	.38	40		
1.75	37.96	.37	45	37.69	
2.0	37.95	.37			
2.5	37.92	.33			
3.0	37.88	.29			
3.5	37.86	.27			
4	37.83	.24			
5	37.80	.21			
6	37.77	.18			
7	37.75	.16			
8	37.73	.14			
10	37.72	.13			
12	37.72	.13			

$Le/r_w = 3.5/0.4 = 8.75$

C = 1.1

$Le/r_w = 3.5/0.5 = 7$

C = 1.0

Bouwer & Rice (cont'd)

IF $r_w = .4$

$$\left(\ln R_e/r_w\right) = \left(\frac{1.1}{\ln(H/r_w)} + \frac{C}{L/r_w}\right)^{-1} \ldots$$

$$= \left(\frac{1.1}{\ln(4.31/.4)} + \frac{1.1}{8.75}\right)^{-1} = (.46 + .13)^{-1} = 1.69.$$

(2.82)

IF $r_w = .5$

$$\left(\ln R_e/r_w\right) = \left(\frac{1.1}{\ln(4.31/.5)} + \frac{1.0}{7}\right)^{-1} = (.51 + .14)^{-1} = 1.54$$

(2.15)

$$K = \frac{r_c^2 \left[1.69\right]}{(2)(5)} \cdot \frac{1}{10} \cdot \underbrace{\ln\left(\frac{0.51}{0.1}\right)}_{.163} = \boxed{1.76 \times 10^{-4}\ ft/min} \cdot \frac{60\,m}{hr} \cdot \frac{24\,hr}{d}$$

$r_c = .08$

$(2)(5) = .00908$

$$= \boxed{.25\ ft/d}$$

$$= \boxed{1.90\ gpd/ft^2}$$

$$K = \frac{ft^2}{ft} \cdot \frac{1}{min} = ft/min$$

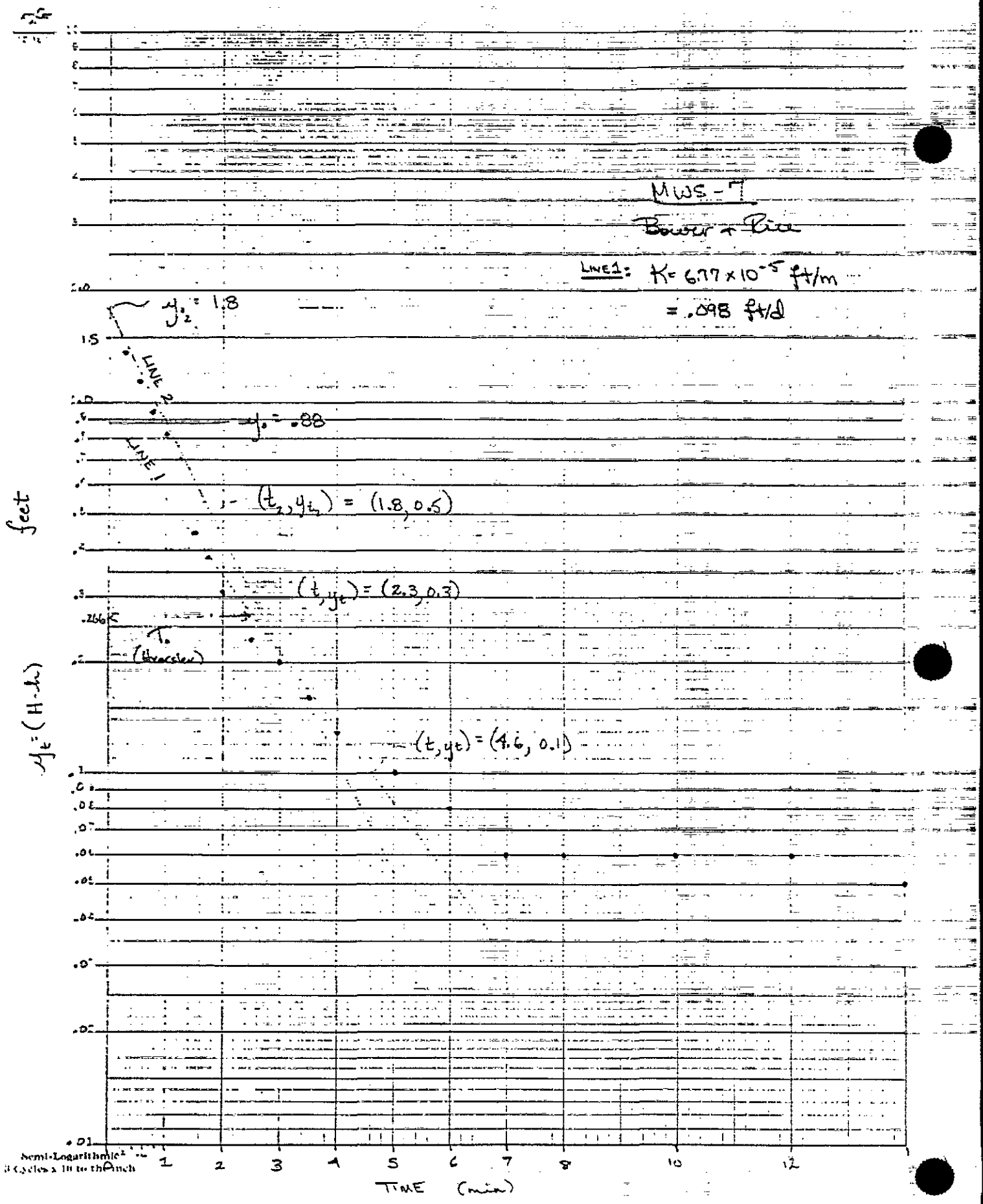
Slug test data

Site : SSC Job No. : ZD3032 Well NO :MWS-5

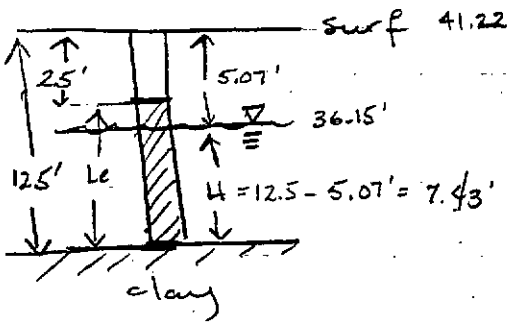
Date:Oct.24,89 Static : 2.81 To.Dept: 5.46 top of pv

TOC Elev = 40.40
Surf Elev = 40.78
Static WL = 37.59
(TOC - 2.81')

TIME	LAPS TIME IN MIN	DEPTH TO WATER IN FT FALGN. HEAD	WATER ELVATN		TIME	LAPS TIME IN MIN	DEPTH TO WATER IN FT RISIGN HEAD	WATER ELVATN.	REMARKS
1128	0.25	2.29	38.11	good	1215	0.25	3.42	36.98	Reference for
	0.5	2.32	38.08			0.5	3.29	37.11	level readings
	0.75	2.33	38.07			0.75	3.27	37.13	is the top
	1	2.37	38.03			1	3.26	37.14	of PVC casing
	1.25	2.39	38.01			1.25	3.22	37.18	
	1.5	2.43	37.97			1.5	3.17	37.23	
	1.75	2.44	37.96			1.75	3.16	37.24	
	2	2.45	37.95			2	3.15	37.25	
	2.5	2.48	37.92			2.5	3.13	37.27	
	3	2.52	37.88			3	3.008	37.392	
	3.5	2.54	37.86			3.5	3.005	37.395	
	4	2.57	37.83			4	3.02	37.38	
	5	2.6	37.8			5	2.83	37.57	
	6	2.63	37.77			6	2.81	37.59	
	7	2.65	37.75			7	2.78	37.62	Above Static
	8	2.67	37.73			8	2.75	37.65	
	10	2.68	37.72		1225	10	2.74	37.66	
	12	2.68	37.72			12	2.73	37.67	
	14	2.69	37.71			14	2.73	37.67	
	16	2.7	37.7			16			
	18	2.71	37.69			18			
1148	20	2.71				20			
1153	25	2.71				25			
	30	2.71				30			
	35					35			
1208	40	2.71				40			
1213	45	2.71				45			
	50					50			
	55					55			
	60					60			
	70					70			
	80					80			
	90					90			


MWS-7
Bouwer & Rice
LINE 1: K = 6.77 x 10^-5 ft/m
= .098 ft/d
y_2 = 1.8
LINE 2
y_1 = .88
(t_2, y_t) = (1.8, 0.5)
(t, y_t) = (2.3, 0.7)
(t, y_t) = (4.6, 0.1)
(Theoretical)
feet
y_t = (H-h)
TIME (min)
Semi-Logarithmic
3 Cycles x 10 to the inch

MWS-7 Bower + Rice



$r_c = .08'$

$r_w = .4'$

$L_e = 9'$ fully penetrating

$H = 7.43'$

$\frac{L_e}{r_w} = \frac{9'}{.4'} = 22.5 \Rightarrow C = 1.7$

MWS-7

t	h	Δh
0	36.15	0
.25	37.54	1.39' = H-H₀
.50	37.30	1.15'
.75	37.09	0.94'
1.00	36.97	0.82'
1.25	36.86	0.71'
1.50	36.60	0.45'
1.75	36.53	0.38'
2.00	36.46	0.31'
2.5	36.38	0.23'
3.0	36.35	0.20
3.5	36.31	0.16
4	36.28	0.13
5	36.25	0.10
6	36.23	0.08
7	36.21	0.06
8	36.21	↓
10	36.21	
12	36.21	
14 ↔ 120	36.20	0.05

$$\left[\ln R_e/r_w\right] = \frac{1.1}{\ln\left(\frac{7.43}{.4}\right)} + \frac{1.7}{225} = 0.452$$

(.38 + .08)

$$K = \frac{r_c^2\left[0.452\right]}{2L_e} \cdot \frac{1}{t} \ln \frac{y_0}{y_t}$$

LINE 1:

$(t, y_t) = (2.3, 0.3)$ or $(4.6, 0.1)$

$y_0 = 0.88$

$$K = \frac{(.08)^2(.452)}{(2)(10)} \cdot \frac{1}{2.3\ \text{or}\ 4.6} \ln \frac{.88}{0.3\ \text{or}\ 0.1}$$

$$K = (1.45\times10^{-4}) \cdot (.473\ \text{or}\ .468) = \boxed{6.77\times10^{-5}\ ft/m}$$

$K = 6.77 \times 10^{-5}$ ft/m

$= 9.75 \times 10^{-2}$ ft/d

$= 7.29 \times 10^{-1}$ gpd/ft²

LINE 2 $t = 18$ $y_t = 0.5$ $y_0 = 1.8$

$$K = (1.45\times10^{-4})\left(\frac{1}{1.8}\ln\frac{1.8}{0.5}\right) = \boxed{1.03\times10^{-4}\ ft/m}$$

$= 1.49\times10^{-1}$ ft/d $= 1.11$ gpd/ft²

Slug test data

Site : SSC Job No. : ZD3032 Well NO :HWS-7

Date:Oct.26,89 Static : 4.48 To.Dept: 9.46 top of pv

TOC Elev = 40.63' } all from PVC 1½' above ground
Surf Elev = 41.22'
Static WL = 36.15'
(TOC - 4.48')

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TIME	LAPS TIME IN MIN	DEPTH TO WATER IN FT FALGN. HEAD	WATER ELVATN.		TIME	LAPS TIME IN MIN	DEPTH TO WATER IN FT RISIGN HEAD	WATER ELVATN.	REMARKS
1032	0.25	3.09	37.54	√(p.o)	1328	0.25	5.63	35	Reference for
	0.5	3.33	37.3			0.5	5.46	35.17	level readings
	0.75	3.54	37.09			0.75	5.29	35.34	is the top
	1	3.66	36.97			1	5.17	35.46	of PVC casing
	1.25	3.77	36.86			1.25	5.46	35.17	
	1.5	4.03	36.6			1.5	4.79	35.84	
	1.75	4.1	36.53			1.75	4.73	35.9	
	2	4.17	36.46			2	4.67	35.96	
	2.5	4.25	36.38			2.5	4.6	36.03	
	3	4.28	36.35			3	4.54	36.09	
	3.5	4.32	36.31			3.5	4.5	36.13	
	4	4.35	36.28			4	4.49	36.14	
	5	4.38	36.25			5	4.46	36.17	about SWL
1038	6	4.4	36.23			6	4.4	36.23	
	7	4.42	36.21			7	4.38	36.25	
	8	4.42	36.21			8	4.38	36.25	
1042	10	4.42	36.21			10			
	12	4.42	36.21			12			
1046	14	4.43	36.2			14			
	16	4.43	36.2			16			
1050	18	4.43	36.2			18			
	20	4.43	36.2			20			
1057	25	4.43	36.2			25			
1102	30	4.43	36.2			30			
	35	4.43	36.2			35			
	40	4.43	36.2			40			
1129	50	4.43	36.2			45			
	60	4.43	36.2			50			
1142	70	4.43	36.2			55			
	85	4.43	36.2			60			
	100	4.43	36.2			70			
1232	120	4.43	36.2						